LOCH RAVEN EAST

Small Watershed Action Plan: Final Report

Prepared for
Department of Environmental
Protection and Sustainability

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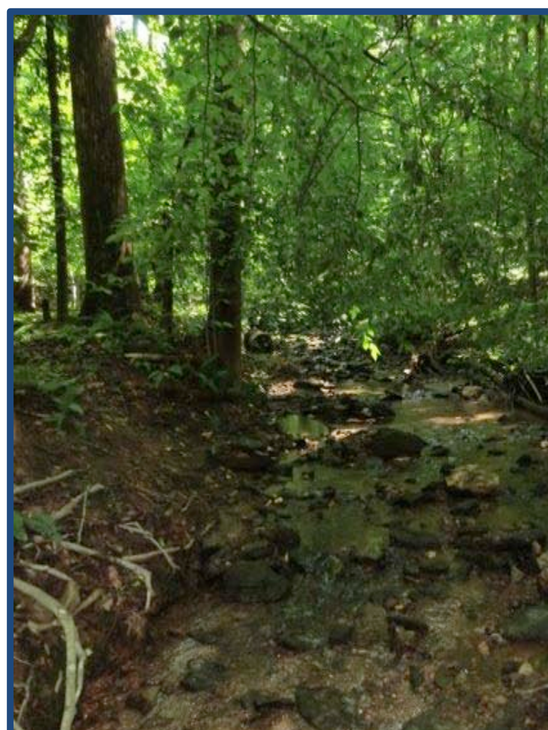

Baltimore County Executive Kevin Kamenetz and the Baltimore County Council

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TABLE OF CONTENTS

TABLES

FIGURES

APPENDIX

ACKNOWLEDGEMENTS

Area R Steering Committee

The Area R SWAP was developed with cooperation and input from citizen organizations, local and state agencies that represent the interests of the Area R watershed.

Name	Organization
Clark Howells	Baltimore City Reservoir Natural Resources Section
Joanie Beam	Baltimore County Department of Environmental Protection and Sustainability (EPS) – Watershed Restoration
Steven Stewart Erin Wisnieski	Baltimore County Department of Environmental Protection and Sustainability (EPS) – Watershed Management and Monitoring
Jessie Bialek	Baltimore County Office of Planning
Jim Ensor	Baltimore County Soil Conservation District
Neely Law Bill Stack	Center for Watershed Protection
Peggy Perry Nancy Pentz	Gunpowder Valley Conservancy (GVC)
Jim Bole	Mid-Atlantic Off Road Enthusiasts (MORE)
Scott Corey	Long Green Land Trust
Don Dodson	Hunt Valley Golf Course
Marion Romans	Glen Arm Garden Club
Sarah Witcher	Gunpowder Falls State Park
Krisztian Varsa	UMD Sea Grant Extension

EXECUTIVE SUMMARY

The Area R watershed lies in the Piedmont region of Maryland and is located in central Baltimore County. It is approximately 11,567 acres (18.1 mi^2) and part of the Loch Raven Reservoir watershed, exclusive of the Prettyboy Watershed area. The watershed is divided into six smaller drainage areas known as subwatersheds: Dulaney Valley Branch, Jenkins Run, Fitzhugh Run, Overshot Run, Green Branch and Royston Run . The Area R watershed is located outside the Urban Rural Demarcation Line (URDL), which ensures limited development in the watershed. The land use in the watershed is dominated by low density residential (30.8%), forest (35.0%), and agriculture (17.5%). The watershed has a low impervious cover of 4.8%.

Area R contains 8.2% of the Loch Raven Reservoir watershed drainage area. The Loch Raven Reservoir watershed is listed as impaired in the Maryland 303(d) list of impaired waters for several pollutants of concern including: fecal coliform (2008 listing), methylmercury (2002 listing), sedimentation and siltation (1996 listing), total phosphorous (1996 listing) and impacts to benthic/fish communities (2002 listing) (MDE, 2008). Four TMDLs have been completed for the Loch Raven Reservoir watershed. TMDLs developed for total phosphorus and sedimentation/siltation were approved by the US Environmental Protection Agency (EPA) in 2007 and identified a target reduction of 50% for total phosphorus and 25% for sediment. A TMDL for fecal coliform bacteria was approved by EPA in 2009 and the bacteria monitoring station downstream of Area R requires an 80.2% reduction in bacteria (MDE, 2009). A summary of the load reductions is provided in Table E- 1. A TMDL for methylmercury in fish tissue was also approved by EPA in 2004 and identified atmospheric deposition as the primary source of mercury with limited options to address mercury through stormwater discharges or practices. According to the Maryland Department of Environment (MDE) the stream biological community impairment listing has a low priority and a Total Maximum Daily Load (TMDL) will be developed at some point in the future.

Table E- 1: Loch Raven East Total Phosphorus, Nitrogen and Sediment Load Reduction Requirements

Area (Acres)	Total Phosphorus (lbs/yr)	Total Phosphorus Source	Total Nitrogen (lbs/yr)	Total Nitrogen Source	Total Sediment (lbs/yr)	Total Sediment Source
11,567	4,817	Urban, Agriculture and Forest	128,694	Urban, Agriculture, Forest and Septic Systems	3,835,359	Urban, Agriculture and Forest
50% TP Reduction:	2,409		0			
25% TS Reduction:			0		958,840	

The Area R Small Watershed Action Plan (SWAP) includes a watershed restoration plan and implementation strategy that will serve as a work plan for restoring and protecting water quality and aquatic terrestrial habitats and for addressing the need for environmental outreach and education in the watershed. The SWAP defines nine goals and thirty associated objectives for clean water, stream protection, forest and habitat, agricultural practices, stewardship and recreation. These goals and objectives are translated into 54 actions that when implemented will result in achieving the goals stated in the SWAP and assist the county in meeting their Chesapeake Bay TMDL load reduction target by 2025.

Implementation of the Area R SWAP will require the cooperative effort of Baltimore County, Gunpowder Valley Conservancy, Baltimore County Soil Conservation District, and local citizen based environmental organizations. To facilitate this cooperative effort an Implementation Committee has been formed to coordinate efforts and jointly seek additional funding to increase the rate of implementation. The Implementation Committee will use an adaptive management approach to ensure maximum effectiveness in implementing actions, and when necessary adjusting the work plan to meet the goals.

CHAPTER 1
Introduction

1.1 Purpose

This Small Watershed Action Plan (SWAP) is a strategy for the restoration and protection of Loch Raven East, referred to as Area R in this report. The report presents the plan for watershed restoration, describes management strategies for each of the six subwatersheds comprising Area R and identifies priority projects for implementation. A schedule for implementation through 2025 that aligns with the timeframe for the Maryland pollutant reduction targets for the Chesapeake Bay TMDL is presented in addition to planning level cost estimates where feasible. Financial and technical partners for plan implementation are suggested for the various recommendations. This SWAP is intended to assist Baltimore County Department of Environmental Protection and Sustainability (EPS), the Gunpowder Valley Conservancy (GVC), and other partners to keep moving forward with the restoration and protection of Area R.

1.2 Background

A SWAP identifies strategies for bringing a small watershed into compliance with water quality criteria. Strategies include a combination of government capital projects, actions in partnership with local watershed associations, citizen awareness campaigns and volunteer activities. Effective implementation of watershed restoration strategies requires the coordination of all watershed partners and the participation of many stakeholders.

Over the past year, Area R partners have worked together, conducting field assessments, identifying restoration and protection opportunities, and engaging the community, in order to build a successful plan. A Steering Committee, consisting of watershed partners, was formed to develop the Area R SWAP. This includes Baltimore County personnel, members of the Gunpowder Valley Conservancy, a representative from Baltimore City Reservoir Natural Resources program, University of Maryland Sea Grant Extension, Soil Conservation District and leaders from the local community. The Steering Committee met six times to provide input and guidance on the development of the SWAP document. Area R Steering Committee members are listed in Table 1-1.

Table 1-1: Area R Steering Committee Members

Name	Organization
Clark Howells	Baltimore City Reservoir Natural Resources Section
Joanie Beam	Baltimore County Department of Environmental Protection and Sustainability (EPS) – Watershed Restoration
Steven Stewart Erin Wisnieski	Baltimore County Department of Environmental Protection and Sustainability (EPS) – Watershed Management and Monitoring
Jessie Bialek	Baltimore County Office of Planning
Jim Ensor	Baltimore County Soil Conservation District
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Scott Corey	Long Green Land Trust
Don Dodson	Hunt Valley Golf Course
Marion Romans	Glen Arm Garden Club
Sarah Witcher	Gunpowder Falls State Park
Krisztian Varsa	UMD Sea Grant Extension

In addition, two community meetings were held during the SWAP development to inform and receive input from the broader public. Community meetings are intended to raise citizen awareness and solicit feedback from residents in neighborhoods, leaders from the local community, institutions and business associations regarding watershed restoration strategies. A description of each meeting including date, approximate number of attendees and topics presented is provided below.

- **Community Meeting #1** (January 23, 2013; 35 attendees): This meeting included an introduction to the SWAP process, the local watershed organization (Gunpowder Valley Conservancy, GVC), and the Area R Steering Committee members. A description of watersheds, county goals, environmental requirements (see Section 1.2), and a SWAP framework was presented. The current conditions of Area R were presented based on a desktop analysis and the field assessments conducted. The GVC provided an overview of their organization and the programs they provide. The draft vision and goals were presented and attendees were asked to identify the top three most important watershed goals.

- **Community Meeting #2** (November 7, 2013; 22 attendees): An overview of the SWAP developed for the Area R watershed was presented. This presentation included an overview of the SWAP process, watershed vision and goals, major watershed characterization, municipal and citizen strategies, pollutant removal analysis, subwatershed prioritization, and SWAP implementation. A presentation on the care and maintenance of septic systems was provided by Baltimore County along with a presentation from the GVC. Last, EPS provided a presentation on where to find more information about the SWAP and how to get involved in the implementation process.

1.2 Environmental Requirements

This SWAP was developed to satisfy environmental program requirements while also meeting citizen needs for a healthy environment, clean water, and an aesthetically pleasing community. The following environmental program requirements and regulations were considered during the development of this SWAP and are briefly described in the sections below.

- National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit assessment and planning requirements

- Local Total Maximum Daily Load (TMDL) reductions for total phosphorus, sediment, bacteria, and methylmercury for Area R; also impairment of benthic and fish communities

- Chesapeake Bay TMDL reductions for nutrients (total nitrogen, total phosphorus) and sediment to meet water quality standards

- Baltimore Reservoir Watershed Management Program commitments

- Maryland Fertilizer Use Act of 2011

- Maryland Department of Agriculture’s Revised Nutrient Management Regulations

1.2.1 NPDES MS4 Permit

Many requirements of Baltimore County's NPDES permit (99-DP-3317(MD0068314)) will be addressed by this plan. One of these requirements is to systematically assess the water quality and develop restoration plans for all watersheds within the county. These assessments must include the following:

- Provide for public participation in the development and implementation of watershed restoration activities
- Determine current water quality conditions
- Identify and rank water quality problems
- Identify all structural and non-structural water quality improvement opportunities
- Report the results of a visual watershed inspection
- Specify an estimated cost and a detailed implementation schedule for identified improvement opportunities

The county's existing NPDES permit also requires the county to address runoff from 20 percent of existing impervious cover. The NPDES permit for the next cycle is not finalized, but new requirements under the draft permit include increasing impervious area treatment goals, supporting regional trash reduction strategies, and continue implementing Environmental Site Design (ESD) technologies for new and redevelopment projects to the Maximum Extent Practicable (MEP). The County will also be required to develop and implement plans to address stormwater waste load allocations (WLAs) established under EPA-approved total maximum daily load (TMDL) estimates. In terms of meeting the Chesapeake Bay TMDL nutrient and sediment reduction targets, the county developed a Phase II Watershed Implementation Plan (WIP) in 2012 (http://www.mde.state.md.us/programs/Water/TMDL/TMDLImplementation/Documents/FINAL_PhaseII_Report_Docs/Final_County_WIP_Narratives/Baltimore_County_WIPII_2012.pdf).

1.2.2 Local TMDLs

Area R contains 8.2% of the Loch Raven Reservoir watershed drainage area. The Loch Raven Reservoir watershed is listed as impaired in the Maryland 303(d) list of impaired waters for several pollutants of concern including: fecal coliform (2008 listing), methylmercury (2002 listing), sedimentation and siltation (1996 listing), total phosphorous (1996 listing) and impacts to benthic/fish communities (2002 listing) (MDE, 2008). Table 1-2 provides a summary of the impairment listing and status.

Impairment listings reflect the inability to meet water quality standards for the designated uses. The Maryland Department of the Environment (MDE) has designated the Gunpowder

River above Loch Raven Reservoir as Use III-P, defined as Nontidal Cold Water and Public Water Supply. The designated uses include: water contact sports, leisure activities involving direct contact with surface water, fishing, growth and propagation of trout and other fish, aquatic life and wildlife, agricultural water supply, industrial water supply, and public water supply.

Four TMDLs have been completed for the Loch Raven Reservoir watershed (Table 1-2). These include sedimentation/siltation, total phosphorus, fecal coliform, and methylmercury-fish tissue. In Area R, the benthic/fish community impairment is most relevant in the first through fourth order streams. However, according to MDE the stream biological community impairment listing has a low priority and a TMDL will be developed at some point in the future (MDE, 2008). While the impairments documented in Area R subwatersheds are a lower priority, they may also be contributing to the downstream impairments in the river mainstem and the reservoir impoundment. In addition, it is important that measures are taken in Area R to help meet the TMDL's for phosphorus, sediment and fecal coliform (based on *E. coli*) which are a problem in the reservoir and mainstem river.

Table 1-2: Water Quality Impairment Listing and Status

Impairment (Year Listed)	Water Type	TMDL Status	Applicable Designated Use
Sedimentation/siltation (1996)	Reservoir	TMDL Approved (2007) [1]	Drinking Water Supply
Total Phosphorus (1996)	Reservoir	TMDL Approved (2007) [1]	Drinking Water Supply
Impacts to Benthic and Fish Communities (based on completed bioassessments, 2002)	Streams (1st – 4th order streams)	TMDL Required	Aquatic Life and Wildlife
Methylmercury-fish tissue (2002)	Reservoir	TMDL Approved (2004)	Fishing
Fecal Coliform (2008)	Streams (Mainstem River)	TMDL Approved (2009)	Water Contact Sports

[1] TMDLs for both total phosphorus and sediment were set simultaneously and are dependent on each other.

A single TMDL was developed for total phosphorus and sedimentation/siltation that was approved by MDE in 2007 and is included as Appendix K. Sources of total phosphorus include surface runoff from urban and agricultural land uses in addition to discharge from small industrial sources and the Hampstead Municipal Waste Water Treatment Plant (WWTP). An abundance of total phosphorus creates an environment of excess nutrients that leads to algal blooms. When the algae die, they consume oxygen from the reservoir that decreases the available oxygen to support aquatic life. The algae can also impart a noxious taste and odor to the drinking water that increases water treatment costs. In order to meet the water quality standards, a 50%

target reduction of total phosphorus was established in 2007. The baseline load for the phosphorus TMDL is based on the long-term average annual load from 1992-1997.

Sources of sediment in the Loch Raven Reservoir include urban, agricultural, and stream erosion. Sediment accumulation within the reservoir limits the storage capacity and therefore impacts its ability to function as a water supply reservoir. Excessive sedimentation can also negatively impact the fish population and recreational uses. Some of the total phosphorus control measures will also control sediment as phosphorus often enters the reservoir attached to sediment particles. In order to meet the water quality standards, a 25% target reduction of total sediment was established in 2007. The baseline load for the sediment TMDL is based on the long-term average annual load from 1992-1997.

The TMDL for fecal coliform bacteria was approved by MDE in 2009 and is included as Appendix J. Fecal bacteria are microscopic single-celled organisms (primarily fecal coliform and fecal streptococci) found in the wastes of warm-blooded animals. Excessive amounts of fecal bacteria in surface water used for recreation result in an increased risk of pathogen-induced illness to humans. Known sources of bacteria include pet, human, livestock, and wildlife categories. In order to meet water quality standards, bacteria levels measured at the monitoring station downstream of Area R must be reduced by 80.2% (MDE, 2009). The baseline load for the fecal bacteria TMDL is based on the average annual load from 2003 and 2004.

The TMDL for methylmercury in fish tissue was approved by MDE in 2004. Based on early data on mercury in fish tissue from a subset of lakes across the state, MDE announced a statewide fish consumption advisory for lakes. This advisory was established statewide as a precautionary measure because the primary source of mercury is understood to be atmospheric deposition, which is widely dispersed. Based on additional fish tissue data, Maryland has verified that Loch Raven Reservoir is impaired due to mercury in fish tissue. Methylmercury is formed from inorganic mercury by the action of anaerobic organisms that live in aquatic systems including lakes, rivers, wetlands, sediments, soils and the open ocean. This methylation process converts inorganic mercury to methylmercury in the natural environment. Limited options exist to address a methylmercury TMDL through stormwater discharge regulations or practices because the pollution is transported through air deposition. In Maryland, the major sources of mercury air emissions are as follows: 43% power plants, 31% municipal waste combustors, 19% medical waste incinerators, 6% Portland Cement plants, and 1% other (e.g., landfills, oil-fired power plants, other industries) (MDE, 2002). Consequently, a portion of mercury air emissions affecting Maryland are generated outside the state and transported here by air movement. The baseline load for the mercury TMDL is based on multiple data sources to generate a long-term average annual load based on data from 1996 through 2001.

1.2.3 Chesapeake Bay TMDL

The Chesapeake Bay TMDL was finalized in 2010 by the EPA to restore the Chesapeake Bay by 2025. This TMDL allocates nutrient and sediment reductions for each bay state and for Maryland that includes a 25 percent reduction in nitrogen, 24 percent reduction in phosphorus and 20 percent reduction in sediment. The load reductions are based on estimates of existing nitrogen, phosphorus and sediment from a 2009 scenario of the Bay Watershed Model (http://www.epa.gov/reg3wapd/tmdl/ChesapeakeBay/tmdlexec.html). These reductions were further broken down by county and major river basin. At the state level, Phase 1 Watershed Implementation Plans (WIPs) were developed to determine how each state will help meet pollutant reductions. Baltimore County developed a Phase II WIP in 2012 that documents its strategy to meet the Chesapeake Bay TMDL nutrient and sediment reduction targets.

1.2.4 Baltimore Reservoir Watershed Management Program

In 1979, Baltimore City, Baltimore County and Carroll County, Maryland developed a formal agreement to manage the three reservoir watersheds (i.e. Liberty, Prettyboy and Loch Raven) that serve as the major drinking water supply for the region to address pollution problems in the reservoirs, as well as provide recreational opportunities and habitat. In 1984, an updated agreement was signed with an Action Strategy for the reservoir watersheds that recommended actions to reduce sediment and nutrient pollution to reservoirs. In 1990, the 1984 Agreement and Action Strategy were reaffirmed by the new political leadership. In 2005, an entirely new Agreement and Action Strategy was developed to address TMDLs and other emerging contaminants of concern (e.g., salt). The signatories to the 2005 agreement include Baltimore County, Baltimore City, Carroll County, Maryland Department of Environment, Maryland Department of Agriculture, Baltimore County Soil Conservation District, Carroll County Soil Conservation District, Reservoir Watershed Protection Committee, and the Baltimore Metropolitan Council. Each signatory made voluntary commitments to implement actions (e.g., BMPs) to meet the water quality goals established in the Agreement.

1.2.5 Maryland Fertilizer Use Act of 2011

The Fertilizer Use Act of 2011 is an environmental law that limits the amount and use of phosphorus and nitrogen in lawn fertilizer products. The major components of the law include content and labeling restrictions, use restrictions by commercial applicators and ‘do-it yourself’ applicators, certification requirements and a homeowner education program about best management practices. The law became fully effective on October 1, 2013.

1.2.6 Maryland Department of Agriculture's Revised Nutrient Management Regulations

The Maryland Department of Agriculture revised nutrient management regulations took effect on October 15, 2012 and will be phased in through March 1, 2020. The revised regulations call for updated nutrient management plans to address the new regulatory requirements, restrictions on organic nutrient use, and best management practices to restrict nitrogen applications.

1.3 USEPA Watershed Planning A-I Criteria

The Clean Water Act (CWA) was amended in 1987 and established the Section 319 Nonpoint Source Management Program, after recognizing the need for federal assistance with state and local nonpoint source efforts. Under this section, states, tribes, and territories can receive grant money for the development and implementation of programs aimed at reducing nonpoint source (NPS) pollution. NPS pollution comes from human activities, wildlife and atmospheric deposition, and is deposited on the ground to eventually be carried to receiving waters by stormwater runoff. Common NPS pollutants and sources include:

- Excess fertilizers, herbicides, and insecticides from agricultural and residential lands
- Oil, grease, and toxic chemicals from urban runoff
- Sediment from improperly managed construction sites, agricultural and forest lands, and eroding stream banks
- Bacteria and nutrients from livestock, wildlife, pet waste, and failing septic systems

CWA Section 319 grant funds can be requested to support nonpoint source related activities such as technical assistance, financial assistance, education, training, technology transfer, restoration projects, and monitoring to assess the success of specific nonpoint source implementation projects. Watershed plans to restore impaired water bodies and address nonpoint source pollution using Section 319 funds must meet USEPA's nine minimum elements, known as the "A through I criteria" for watershed planning. The "A through I criteria" are summarized below:

A. Identification of the causes and sources that will need to be controlled to achieve the load reductions estimated in the watershed plan
B. Estimates of pollutant load reductions expected through implementation of proposed nonpoint source (NPS) management measures
C. A description of the NPS management measures that will need to be implemented

D. An estimate of the amount of technical and financial assistance needed to implement the plan

E. An information/education component that will be used to enhance public understanding and encourage participation

F. A schedule for implementing the NPS management measures

G. A description of interim, measurable milestones

H. A set of criteria to determine load reductions and track substantial progress towards attaining water quality standards

I. A monitoring component to determine whether the watershed plan is being implemented

This Area R SWAP meets the A through I criteria. Table 1-3 shows where these criteria are addressed throughout this document.

1.4 Partner Capabilities

In order to achieve effective watershed restoration, the capabilities of many organizations must be brought together and coordinated. Within Area R, key partner organizations include Baltimore County EPS, Baltimore County Soil Conservation District, Baltimore City Reservoirs, and Gunpowder Valley Conservancy. Other organizations such as University of Maryland Extension, Gunpowder Falls State Park, Mid-Atlantic Off Road Enthusiasts (MORE), Long Green Land Trust (LGLT), and local partners may assist with implementation on a project specific basis.

Table 1-3: U.S. EPA Watershed Planning “A-I” Criteria

Chapter of the Report	USEPA A-I Criteria								
	A	B	C	D	E	F	G	H	I
Chapter 1. Introduction					X				
Chapter 2. Vision, Goals and Objectives					X				
Chapter 3. Restoration Strategies		X	X		X				
Chapter 4. Subwatershed Management Strategies	X		X		X				
Chapter 5. Plan Evaluation				X		X	X	X	X
Appendix A. Area R Action Strategies			X	X	X	X	X		X

Chapter of the Report	USEPA A-I Criteria								
	A	B	C	D	E	F	G	H	I
Appendix B. U.S. Environmental Protection Agency A Through I Criteria for Watershed Planning									
Appendix C. Cost Analysis and Potential Funding Sources				X					
Appendix D. Chesapeake Bay Program Pollutant Load Reduction Efficiencies		X							
Appendix E. Area R Watershed Characterization Report	X		X		X				
Appendix F. Stream Corridor Assessment Survey Data	X								
Appendix G. Uplands Survey Data	X								
Appendix H. Synoptic Survey	X								
Appendix I. Total Maximum Daily Load - Mercury	X								
Appendix J. Total Maximum Daily Load – Bacteria	X								
Appendix K. Total Maximum Daily Load – Phosphorus and Sediment	X								
Appendix L. Biological Assessment	X								

1.4.1 Baltimore County Environmental Protection and Sustainability (EPS)

Baltimore County EPS has a waterway restoration program to implement restoration projects, including stream restoration, stormwater conversions and retrofits, and reforestation projects. Baltimore County has an extensive monitoring program that assesses the current ambient water quality, efficiency of various restoration projects in relation to pollutant removal and biological community improvement, and tracks trends over time. The County also has an illicit discharge and elimination program that monitors storm drain outfalls, tracks pollutant sources, and coordinates remediation.

The County operates street sweeping and inlet cleaning programs throughout the county that remove sediment, nitrogen, and phosphorus before they reach the waterways. These programs are tracked and estimates of the pollution removal are calculated.

1.4.2 Baltimore City Reservoir Natural Resources Section

The City of Baltimore, Reservoir Natural Resources Section, is responsible for the management of the three city-owned drinking water reservoirs (Liberty, Prettyboy and Loch Raven), the surrounding forest buffers, and roadways. Overall, the City manages approximately 24,580 acres of property within Baltimore and Carroll counties. Management activities include water quality monitoring, forest health assessments, roadway and access road maintenance, snow removal, and the development and enforcement of watershed regulations designed to protect the forest buffers and drinking water resources. The Reservoir Natural Resources Section is committed to the protection of the reservoirs and contiguous watershed lands from outside influences that would adversely impact the drinking water resource and interfere with providing the highest quality public water supply to approximately 1.8 million consumers within the Baltimore Metropolitan area.

1.4.3 Gunpowder Valley Conservancy

The Gunpowder Valley Conservancy (GVC), a non-profit organization, serves as a bridge connecting citizens with programs and information that can help them become better stewards of the natural and historical resources in the watershed. The GVC mobilizes people and resources to care for the land, water and character of the Gunpowder watershed. The main focus of the organization is on land preservation, reforestation, stream adoption and education. In addition, the GVC works with homeowners to reduce stormwater runoff from their yard through installation of rain barrels and rain gardens.

1.5 Area R Overview

The Area R watershed is subdivided into six subwatersheds that drain to the Loch Raven Reservoir watershed, as shown in Figure 1-1. Area R is approximately 11,567 acres (18.1 mi^2) or eight percent of the Loch Raven Reservoir watershed, exclusive of the Prettyboy Watershed area.

The Area R watershed is located outside the Urban Rural Demarcation Line (URDL) that ensures limited development in the watershed. The land use in the watershed is dominated by low density residential (30.8%), forest (35.0%), and agriculture (17.5%). The watershed has a low impervious cover of 4.8%. The soils in the watershed consist of mostly hydrologic soil groups B (81.5%) and C (16.1%) with moderate to low infiltration rates. The total population for the watershed is 6,000 people based on the 2010 census, which translates into a low average population density of 0.5 people/acre. The watershed contains 89.1 stream miles. Fourteen miles were assessed in the Dulaney Valley Branch subwatershed during the development of the SWAP and are generally in good condition compared to more urbanized watersheds. However, there are areas of erosion and unstable channel conditions among the sites assessed. Findings from Baltimore County’s 1997 Water Quality Management Plan for Loch Raven Watershed (Tetra Tech, 1997) and the Gunpowder River Watershed Study (DEPRM, 2000) reinforce management approaches that include the creation or enhancement of riparian buffers and restoration of headwater stream systems in developing watersheds or watersheds without appropriate stormwater management.

The six subwatersheds that comprise the Area R watershed are intended to help target restoration, preservation and monitoring efforts. The Area R Watershed Characterization Report includes detailed analyses and descriptions of the current watershed conditions and potential water quality issues. This report is included as Appendix E of this plan. A summary of the key watershed characteristics for Area R based on the characterization report is provided in Table 1-4.

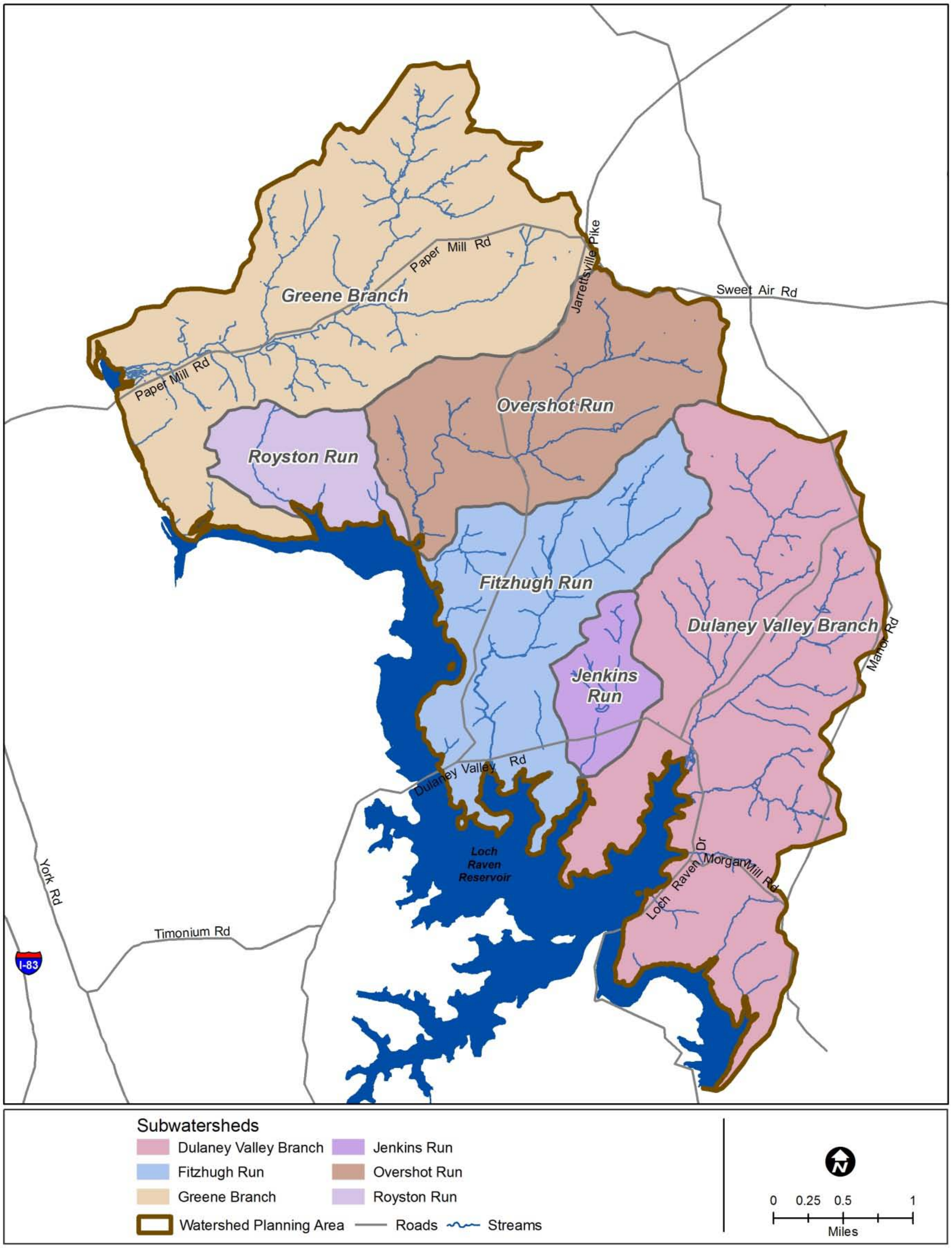

Figure 1-1. Area R SWAP Planning Area.

Table 1-4: Area R Key Watershed Characteristics

Key Watershed Characteristics	Subwatershed						Total
	Dulaney Valley Branch	Fitzhugh Run	Greene Branch	Jenkins Run	Overshot Run	Royston Run	
Drainage Area (acres)	3,577.2 (5.6 mi^2)	1,772.3 (2.8 mi^2)	3,472.4 (5.4 mi^2)	403.9 (0.6 mi^2)	1,782.9 (2.8 mi^2)	558.6 (0.9 mi^2)	11,567.3 (18.1 mi^2)
Stream Miles	23.8	10.8	31.3	3.2	11.0	4.5	84.4
Total Population (2000 Census)	2,026	420	1,926	67	1,193	369	6,000
Land Use/Land Cover (%)							
Very Low Density Residential (Agricultural)	5.2%	6.1%	4.3%	0.0%	3.8%	0.1%	4.4%
Very Low Density Residential (Forested)	5.0%	2.2%	8.3%	0.0%	6.0%	7.6%	5.7%
Low Density Residential	36.6%	11.7%	32.4%	11.5%	34.1%	44.1%	30.8%
Medium Density Residential	0.0%	0.0%	0.3%	0.0%	3.4%	0.0%	0.6%
Commercial	0.0%	0.0%	1.7%	0.0%	0.7%	0.0%	0.6%
Industrial	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Institutional	0.2%	0.0%	0.0%	0.0%	2.3%	0.0%	0.4%
Open Urban Land	0.1%	1.6%	5.4%	31.0%	6.8%	0.0%	4.0%
Agriculture	16.2%	29.4%	15.9%	23.7%	15.7%	0.0%	17.5%
Forest	34.7%	47.2%	30.6%	31.8%	27.1%	45.1%	34.5%
Brush	0.0%	0.2%	0.1%	2.0%	0.0%	0.0%	0.1%
Water	2.0%	1.6%	0.6%	0.0%	0.1%	3.1%	1.2%
Wetlands	0.1%	0.0%	0.4%	0.0%	0.0%	0.0%	0.2%
Impervious Cover (%)	4.6%	3.1%	5.4%	3.3%	6.1%	5.4%	4.8%
Hydrologic Soil Group (%)							
A (low runoff potential)	0.0%	0.0%	0.9%	0.0%	0.8%	0.0%	0.4%

Key Watershed Characteristics	Subwatershed						Total
	Dulaney Valley Branch	Fitzhugh Run	Greene Branch	Jenkins Run	Overshot Run	Royston Run	
B	80.4%	83.2%	81.1%	85.1%	79.7%	88.4%	81.5%
C	18.8%	14.7%	16.1%	12.8%	14.5%	11.6%	16.1%
D (high runoff potential)	0.8%	2.1%	1.8%	2.1%	5.0%	0.0%	2.0%

1.6 Report Organization

This report is organized into the following five major chapters:

Chapter 1 explains the purpose of this report including underlying environmental requirements and key watershed characteristics.

Chapter 2 presents the watershed vision, goals and objectives for restoring the Area R watershed.

Chapter 3 describes the types of watershed restoration practices planned for Area R and estimated pollutant load reductions.

Chapter 4 discusses prioritization of restoration of the six subwatersheds in the Area R watershed and summarizes subwatershed specific restoration and protection strategies.

Chapter 5 presents the implementation plan restoration and protection evaluation criteria and monitoring framework.

This volume (Volume 1) also includes the following appendices with additional, detailed information used to develop and support this SWAP:

- Appendix A: Area R Action Strategies
- Appendix B: U.S. Environmental Protection Agency A Through I Criteria for Watershed Planning

- Appendix C: Cost Analysis and Potential Funding Sources
- Appendix D: Chesapeake Bay Program Pollutant Load Reduction Efficiencies

A second volume (Volume II) includes the following appendices with supporting documentation related to the current conditions of the Area R watershed:

- Appendix E: Area R Watershed Characterization Report
- Appendix F: Stream Corridor Assessment Survey Data
- Appendix G: Uplands Survey Data
- Appendix H: Synoptic Survey
- Appendix I: Total Maximum Daily Load - Mercury
- Appendix J: Total Maximum Daily Load – Bacteria
- Appendix K: Total Maximum Daily Load – Phosphorus and Sediment
- Appendix L: Biological Assessment

CHAPTER 2
Vision, Goals and Objectives

2.1 Vision Statement

The Area R Steering Committee adopted the following vision statement that acted as a guide in the development of the SWAP:

Our vision is for people who live around Loch Raven Reservoir to preserve and sustain the land and water in order to provide clean drinking water supply, healthy streams & habitat and recreational opportunities.

2.2 Area R SWAP Goals and Objectives

The Steering Committee created a vision statement for Area R and identified nine goals to define the desired restoration and protection objectives. The goals were based on input from watershed residents at the first community meeting and revised with input from the Steering Committee. To achieve watershed goals, stakeholders then identified the type of restoration activities that are of interest. The watershed goals, organized by category, are provided below:

GOALS:

Clean Water

- Goal 1: Improve and maintain stream conditions
- Goal 2: Improve and sustain a safe and reliable drinking water supply

Stream Protection

- Goal 3: Protect high quality streams
- Goal 4: Promote environmentally sensitive development

Forest and Habitat

- Goal 5: Support land preservation and restoration to sustain healthy trees and forests
- Goal 6: Restore and maintain aquatic and terrestrial biodiversity

Agricultural Practices

- Goal 7: Promote implementation of conservation practices on agricultural lands

Stewardship

- Goal 8: Increase environmental awareness

Recreation

- Goal 9: Support environmentally-friendly recreation opportunities

The following sections present a discussion of each of the nine goals for restoring and protecting the Area R watershed that are organized by category. For each goal, a series of objectives was developed to ensure that the plan will meet each goal. Measurable action items for each objective are included in Appendix A.

Clean Water

2.2.1 Goal 1: Improve and Maintain Stream Conditions

Fecal bacteria are microscopic single-celled organisms (primarily fecal coliform and fecal streptococci) found in the wastes of warm-blooded animals. Excessive amounts of fecal bacteria in surface water used for recreation are known to indicate an increased risk of pathogen-induced illness to humans. A Total Maximum Daily Load (TMDL) for fecal coliform was developed for the tributaries that drain to the Loch Raven Reservoir. The primary sources of fecal coliform identified in the TMDL are wildlife (mammals and waterfowl), humans (septic systems), pets, and livestock (agricultural livestock). There is need to reduce bacteria by 80.2% in the Loch Raven Reservoir tributaries to meet the TMDL requirement. Reductions in bacterial contamination in streams can be achieved through TMDL implementation in both the urban and rural sections of Area R. Although a TMDL for the biological impairment has yet to be developed, this impact has been listed for the 1st through 4th order streams within the watershed.

Objectives:

1. Meet TMDL goal to reduce bacteria by 80% for streams.
2. Remove the biological impairment for streams.
3. Conduct bacteria monitoring surveys to focus remediation efforts in the subwatersheds.

2.2.2 Goal 2: Improve and Sustain a Safe and Reliable Drinking Water Supply

Area R drains into the Loch Raven Reservoir watershed that is designated as a Use III-P, defined as Nontidal Cold Water and Public Water Supply. Throughout the watershed, stormwater runoff carries sources of pollution to streams. Actions are needed in Area R to help achieve the phosphorus and sediment TMDL for the Loch Raven Reservoir watershed. Reducing sources of non-point source pollution and implementing the most effective stormwater management and stewardship actions will reduce pollution in streams and the reservoir.

Objectives:

1. Meet TMDL goal to reduce phosphorus by 50% for the reservoir.
2. Meet TMDL goal to reduce sediment by 25% for the reservoir.

<u>Stream Protection</u>

2.2.3 Goal 3: Protect High Quality Streams

The streams in Area R are currently in fair to good condition and some support trout populations. In addition, Area R currently has a low impervious cover of 4.8 percent which is an indicator of good stream health (Schueler et al. 2009). The Fish and Benthic Index of Biotic Integrity (IBI) data indicate a majority of sites in good condition throughout the watershed with well-forested, lightly developed stream reaches. Activities should be taken to protect these high quality streams to include the continuing use of Environmental Site Design that conserves and protects natural resources during site development.

Objectives:

1. Provide adequate forest buffers to protect 100 percent of the streams on public lands to support native fish populations.

2.2.4 Goal 4: Promote Environmentally Sensitive Development

The strategy for this goal is to ensure that development occurs in an environmentally sensitive fashion. Environmentally sensitive development reduces the impact on the land by preserving natural areas, providing on-site stormwater treatment, and minimizing the creation of impervious surfaces. This type of development limits the amount of disturbance to conservation areas including forest and open land. A reduction in runoff and pollutant loads is achieved through the use of stormwater management facilities that include filtration/infiltration techniques in addition to the reduction of impervious cover.

Objectives:

1. Continue to apply Baltimore County’s forest buffer regulations to enhance and protect streams.
2. Continue to apply the Forest Conservation Regulations.
3. Reduce sediment runoff from construction sites by applying the enhanced erosion and sediment control requirements adopted November 17, 2012 by the County Council (Bill 72-12).

4. Enhance and protect natural resources.
5. Continue to use Environmental Site Design (ESD) guidance.
6. Maintain low density development in areas with good water quality.

Forest and Habitat

2.2.5 Goal 5: Support Land Preservation and Restoration to Sustain Healthy Trees and Forests

Trees and forests provide a host of benefits that include cleaning the air we breathe, reducing stormwater runoff and pollutants, providing habitat for wildlife, reducing the cost of heating and cooling, and providing recreation and aesthetic benefits. Trees and forests reduce stormwater runoff through evapotranspiration into the air and infiltration of rainwater into the soil. The presence of trees also helps to slow down and temporarily store runoff, which further promotes infiltration, and decreases flooding and erosion downstream. In addition, trees and forests reduce pollutants by transforming them into less harmful substances.

Objectives:

1. Support proper buffer management (e.g. tree planting, invasive plant removal) of contiguous forest patches with private and public land owners.
2. Increase native tree populations.
3. Promote restoration of natural habitats.
4. Reduce exotic invasive plants in forest areas on private and public properties.
5. Encourage deer management to sustain healthy herd populations that reduces their negative impact on forest habitat and citizen enjoyment.
6. Maintain and restore the health of watershed forests and promote sustainable forest management.
7. Promote land conservation easements through local land trusts and county and state funding.
8. Encourage landowners to implement reforestation projects and to seek available funding.

2.2.6 Goal 6: Restore and Maintain Aquatic and Terrestrial Biodiversity

Biodiversity in native, ecosystem-appropriate aquatic and terrestrial species is an indicator of a healthy watershed. Enhancing and maintaining the native aquatic and terrestrial biodiversity in Area R will preserve habitats and ecosystems in the Loch Raven Reservoir and

Chesapeake Bay. Addressing the Maryland 303 (d) listed impairment for impacts to the benthic/fish community will help maintain a balanced ecosystem.

Objectives:

1. Restore and protect portions of the stream network, such that conditions can support diverse aquatic and riparian communities.
2. Protect and enhance trout habitat.
3. Manage deer populations to support diverse habitat and wildlife populations.

Agricultural Practices

2.2.7 Goal 7: Promote the Implementation of Conservation Practices on Agricultural Lands

Agricultural practices (cropland, orchards, and pasture including horse farms) make up the third largest land use (17.5 percent) in Area R. This goal attempts to integrate the use of established, as well as new or innovative, conservation practices on all agricultural lands. There are a large number of proven agricultural practices that can be used by farmers to reduce pollutant runoff by reducing soil loss, trapping nutrients, and minimizing the amounts of nutrients and pesticides used on the land. The use of these practices will also help meet other watershed goals to maintain and restore stream conditions and aquatic biodiversity, and reduce pollution from stormwater runoff including bacteria.

Objectives:

1. Promote agricultural conservation/best management practices designed to improve water quality.
2. Inform the agricultural community on the need to improve the quality of stream buffers.
3. Encourage preservation and stewardship through conservation easements.

Stewardship

2.2.8 Goal 8: Increase Environmental Awareness

Direct outreach to communities in the watershed is key to the success of the SWAP. Resources need to be available to increase awareness of actions people can take in their neighborhoods and on their individual properties to enhance water quality and monitor stream conditions. Connecting stakeholders to the high quality resources in the watershed, including recreational activities within the Loch Raven Water Quality Management Area (WQMA), provide opportunities for environmental awareness. The WQMA is the land surrounding the reservoir that acts as a buffer, protecting the water quality from pollutants associated with development and stormwater runoff.

Objectives:

1. Effectively communicate the mission of the SWAP and the importance of a healthy watershed to community groups and leaders.
2. Promote conservation practices for homeowners, children and institutions.

<u>Recreation</u>

2.2.9 Goal 9: Support Environmentally-Friendly Recreation Opportunities

Recreation in the Loch Raven Reservoir provides opportunities for the public to appreciate and experience the bountiful wildlife, habitat and water resources in Baltimore County. The following recreational activities, which have minimal impact on the natural environment, are permitted in the WQMA with some restrictions: biking in approved areas, fishing from watercraft, bank fishing, use of approved watercraft, picnicking (no fires), hiking, horseback riding, bow and arrow hunting (whitetail deer only), bird watching, and other activities outside of the Area R watershed (e.g., skeet shooting at the Loch Raven Skeet and Trap Center), and golf (only at Pine Ridge Golf Course).

Objectives

1. Increase awareness of safe and eco-friendly use of recreation opportunities.
2. Encourage golf courses to limit their environmental impact (e.g. Audubon Cooperative Sanctuary Program for Golf Courses (ACSP)).

CHAPTER 3

Restoration Strategies

3.1 Introduction

This chapter presents an overview of the key restoration strategies and associated pollutant load reductions proposed for restoring the Loch Raven East watershed. A complete list of actions proposed for the watershed including goals and objectives targeted, timelines, performance measures, cost estimates, and responsible parties is included in Appendix A.

The key restoration strategies are the focus of this chapter ranging from stream restoration capital projects to public education and outreach. It is important that a combination and variety of restoration practices are implemented to engage citizens and meet watershed-based goals and objectives.

The Loch Raven East watershed restoration and preservation will occur as a partnership between the local government, watershed groups and citizens. All partners are critical to the success of the overall watershed restoration strategy. Local governments can implement large capital projects such as stormwater retrofits, stream restoration, changes in municipal operations, and large-scale public awareness. Watershed groups and citizens can implement locally based programs such as tree planting and downspout disconnection that require citizen participation, and increase awareness. Therefore, key restoration strategies are divided into three categories: urban municipal strategies (Section 3.2), urban citizen-based strategies (Section 3.3), and agricultural best management practices (Section 3.4). It is important that all groups are active in restoration activities and that a variety of projects are implemented. The watershed pollutant loading analysis performed to estimate current nutrient loads generated by the various non-point sources within the Loch Raven East watershed is discussed in Section 3.5. Section 3.6 discusses the pollutant removal calculations for the existing and proposed best management practice (BMP) strategies presented in Sections 3.2 to 3.4 to ensure that total maximum daily load (TMDL) requirements are met in the Loch Raven East watershed.

3.2 Urban Municipal Strategies

The Baltimore County government works to restore local streams and improve water quality through capital improvement projects and municipal management activities (e.g., development review, street sweeping, illicit connection programs, etc.). This plays an important role in the SWAP implementation process. Key municipal strategies proposed for restoring Loch Raven East are discussed in the following sections.

3.2.1 Stormwater Management

Increased importance of water quality and water resource protection led to the development of the Maryland Stormwater Design Manual which provided BMP design standards and environmental incentives (MDE, 2000). The manual was updated to adopt low impact practices that mimic natural hydrologic processes to restore pre-development conditions. The Maryland Stormwater Act of 2007 requires that all new development adopt environmental site design (ESD) to the maximum extent practicable via nonstructural BMPs and/or other improved site design techniques. The intent of ESD BMPs is to distribute and reduce flow through multiple small BMPs throughout a development site and reduce stormwater runoff leaving that site. This will also reduce pollutant loads and sediment caused by erosive velocities. A total of 27 existing SWM facilities are located within the Loch Raven East watershed including dry and wet ponds, infiltration/filtration practices, extended detention, and proprietary BMPs. Existing SWM facilities treat a total drainage area of approximately 126.8 acres of urban land or 2.4 percent of the total urban land use in the watershed.

3.2.2 Stormwater Retrofits

Stormwater retrofits involve implementing BMPs in existing developed areas where SWM practices do not exist to help improve water quality or include enhancements or conversions of existing SWM practices. Stormwater retrofits improve water quality by capturing and treating runoff before it reaches the receiving water body. Potential sites for upland stormwater retrofits within the conveyance system were identified in several locations. Potential retrofits include the conversion of cul-de-sacs that are potential sites for bioretention retrofits in five neighborhoods, installation of bioretention at one institutional site, the conversion of grass ditches at an institutional site, regenerative stormwater conveyance in one neighborhood and two institutional sites. SWM facilities constructed prior to the Maryland’s 2007 Stormwater Management Act that requires Environmental Site Design (ESD) may also be candidates for retrofits.

Impervious surfaces including roads, parking lots, rooftops, and other paved surfaces prevent precipitation from naturally infiltrating into the ground. As a result, impervious surface runoff can result in erosion, flooding, habitat degradation, and increased pollutant loads in receiving water bodies. Subwatersheds with high amounts of impervious cover are more likely to have degraded stream systems and are larger contributors to water quality problems in a watershed than those that are less developed as discussed in Appendix E, Chapter 2.3.3. Removing impervious cover and converting to pervious or forested land will help promote infiltration of runoff and reduce pollutant loads from overland runoff. There were no areas identified for impervious cover removal in Loch Raven East. While not included in pollutant reduction calculations, awareness and outreach tools could be used to inform residents of the water quality impacts associated with large impervious parking lots, driveways or patios and the options available for conversion to, or incorporating more, permeable surfaces.

3.2.3 Stream Corridor Restoration

Stream restoration practices are used to enhance the appearance, stability, and aquatic function of urban stream corridors. Stream restoration practices range from routine stream cleanups and simple stream repairs such as vegetative bank stabilization and localized grade control to comprehensive repairs such as full channel redesign and realignment. Stream corridor assessments (SCAs) performed in the Loch Raven East watershed showed opportunities for stream repair and buffer reforestation. Stream segments identified during the SCAs with significant erosion and channel alteration are used to estimate pollutant load reductions which would result from stream repair efforts. Stabilizing the stream channel improves water quality by preventing soils, and the pollutants contained in them, from eroding from the bank and entering the waterway. Lengths of eroded and altered channel segments were recorded during the SCAs.

3.2.4 Reforestation/Tree Planting

Trees provide aesthetic value, and air and water quality benefits. They can provide shade and absorb nutrients through their root systems while also providing habitat for wildlife. Tree planting incentive programs mentioned previously can also help increase the success of planting efforts. Converting open areas in the upland portion of the watershed to forested areas through tree plantings can also reduce nutrient inputs to nearby water bodies and reduce erosion. Two of the five pervious areas assessed within the Loch Raven East watershed were identified as potential areas for tree planting. Publicly-owned lands provide additional sites for tree planting and are targeted for initial reforestation efforts. Three of the five pervious areas assessed within the Loch Raven East watershed are publicly-owned land, with portions of the total 273 county-owned acres available for tree planting.

3.3 Urban Citizen-Based Strategies

The participation of citizens in watershed restoration is an essential part of the SWAP process. When large numbers of individuals become involved in citizen-based water quality improvement initiatives, changes can be made to the aesthetic and chemical aspects of water bodies within the watershed that would otherwise not be possible. Citizen participation is critical to the implementation and long-term maintenance of restoration activities. Key citizen-based strategies proposed for restoring the Loch Raven East watershed are discussed in the following sections.

3.3.1 Reforestation

Trees help improve water quality by capturing and removing pollutants in runoff including excess nutrients through their roots before the pollutants enter groundwater and streams. Tree leaves and branches also intercept precipitation which helps to reduce the energy of raindrops and prevent erosion resulting from their impact on the ground. In addition to water quality improvements, trees provide air quality, aesthetic and economic benefits. For example, trees strategically planted around a house can form windbreaks to reduce heating costs in the winter and can provide shade which reduces cooling costs in the summer. Incentive programs, such as Tree-Mendous Maryland http://www.dnr.state.md.us/forests/treemendous, the State Highway Administration’s Partnership Program for public property, and the Baltimore County Big Trees Sales for private residential properties http://www.baltimorecountymd.gov/Agencies/environment/forestsandtrees/bigtrees.html, help increase successful planting efforts. Several areas throughout the watershed are targeted for reforestation opportunities that are described in the following sections.

Riparian Buffer

Stream riparian buffers are critical to maintaining healthy streams and rivers. Forested buffer areas along streams can improve water quality and prevent flooding since they filter pollutants, reduce surface runoff, stabilize stream banks, trap sediment, and provide habitat for various types of terrestrial and aquatic life including fish. Buffer encroachment from development was noted during stream surveys conducted throughout the watershed. Nine out of the 30 neighborhoods were recommended for better stream buffer management due to encroachment. These sites can be improved through reforestation, therefore increasing the lot's tree canopy. These areas can be targeted for buffer awareness initiatives to encourage landowners to plant trees and/or create a no-mow area adjacent to streams. Urban open pervious (lawn) areas identified within the 100-foot stream buffer during the stream assessment and through a GIS analysis discussed in Appendix E are also good candidates for tree planting and are targeted for initial buffer reforestation efforts.

Urban Nutrient Management

Many common activities around homes can have a negative effect on water quality. Yards and lawns typically represent a significant portion of the pervious cover in an urban subwatershed and therefore, can be a major source of nutrients, pesticides, sediment, and runoff. Maintenance behaviors tend to be similar within individual neighborhoods and certain activities can impact subwatershed quality such as fertilizer, herbicide and pesticide use, lawn watering, landscaping, and trash/yard waste disposal. Urban nutrient management efforts related to lawn maintenance and Bayscaping can help reduce nutrient loads to nearby streams. Citizen awareness and behavior change is key to improved urban nutrient management.

Lawn Maintenance Education

Lawn maintenance activities often involve over-fertilization, improper use of herbicides and pesticides, and over-watering resulting in polluted runoff to local streams. Lawns with a dense, uniform grass cover or signs designating poisonous lawn care indicate high lawn maintenance activities. Neighborhoods identified as having high lawn maintenance issues are targeted for awareness programs emphasizing responsible fertilizing techniques such as proper application rates and time of year for fertilization, soil testing for nutrient requirements and keeping fertilizers off impervious surfaces. Lawn maintenance education can be achieved through door-to-door canvassing, informational brochures/mailing, excerpts in community newsletters, or demonstrations at community meetings. Information on organic alternatives to chemical lawn treatments should also be included in these outreach efforts. During the Neighborhood Source Assessment, 18 neighborhoods where 20 percent or more of the homes employ high lawn maintenance practices were identified for a fertilizer reduction/education program.

Bayscaping

Reducing the amount of mowed lawn and increasing landscaping features provides water quality benefits through interception and filtration of stormwater runoff. Bayscaping refers to the use of plants native to the Chesapeake Bay watershed for landscaping. Because they are native to the region, these plants require less irrigation, fertilizer, herbicides and pesticides to maintain as compared to non-native or exotic plants. This means that there will be less stormwater pollution and lawn maintenance requirements. Bayscaping is also beneficial to wildlife. Similar to lawn maintenance education, Bayscaping awareness can be raised through informational brochures/mailings, excerpts in community newsletters, or demonstrations at community meetings. A combination of outreach/awareness techniques and financial incentives can be used to implement a Bayscaping program. Twenty-three neighborhoods were identified as potential candidates during the Neighborhood Source Assessment.

Maryland Fertilizer Use Act of 2011

The Maryland Fertilizer Use Act took effect in October 2013 and bans phosphorus in most fertilizer products and provides a greater percentage of slow release nitrogen in fertilizer. Fertilizer bags sold in hardware stores and nurseries now have better labeling, and large applicators will have to be certified in proper fertilizer application. The acres of pervious urban land that this act applies to were calculated using GIS.

3.4 Agricultural Best Management Practices

There are many agricultural practices used by farmers to reduce soil loss, trap nutrients, and minimize nutrient and pesticide use on the land. Key agricultural BMPs proposed for restoring the Loch Raven East watershed are discussed in the following sections.

3.4.1 Soil Conservation and Water Quality Plans

A Soil Conservation and Water Quality Plan (SCWQP) is a comprehensive plan that addresses natural resource management on agricultural lands. It describes BMPs which will be used to control erosion and sediment loss, and manage runoff. SCWQPs include management practices such as crop rotations, and structural practices such as waterways and stream fencing. At the request of a farmer, a Soil Conservation District, Maryland Department of Agriculture (MDA) or USDA professional provides assistance to determine the practices needed to address specific runoff concerns on the farm. The practices are designed to control erosion within acceptable levels and to be compatible with management and cropping systems. A SCWQP can be used for up to ten years without revision if substantial changes in management do not occur. Nutrient reduction is only one of many benefits derived from SCWQPs. Also included in a SCWQP are recommendations concerning forestry management, wildlife habitat and plantings, and other natural resource management practices. Based on data obtained from the Baltimore County Soil Conservation District, there are 25 SCWQPs in the Loch Raven East watershed. Best Management Practices that can be included in a SCWQP that apply to Loch Raven East are discussed below.

Streamside Forest Buffers

Streamside forest buffers are wooded areas along rivers and streams that help filter nutrients, sediments and other pollutants from runoff as well as remove nutrients from groundwater and reduce erosion. In addition to their ability to improve water quality, their value at enhancing terrestrial and aquatic habitat make forest buffers an important BMP for natural resources managers. Agricultural open pervious areas identified within the 100-foot stream buffer during the stream assessment, and through a GIS analysis in Appendix E, are good candidates for tree planting and are targeted for initial buffer reforestation efforts as identified in Appendix A.

Stream Protection with Fencing

Stream protection with fencing incorporates both alternative watering and installation of fencing along streams to exclude livestock. The fenced areas may be planted with trees or grass, but are typically not wide enough to provide the benefits of buffers. Stream fencing should be implemented so as to substantially limit livestock access to streams; however, it can allow for the use of limited hardened crossing areas if other options aren't possible to accommodate access to additional pastures or for livestock watering. By preventing or limiting access of livestock to streams, erosion from hooves and bacteria/nutrient contamination from livestock in the stream is reduced. An assessment of acres for fencing is based on a GIS analysis of a cattle farm in the watershed.

Off-Stream Watering

Off-stream watering provides cattle an alternative drinking water source away from streams. By providing an off-stream watering source, livestock will reduce the time they spend near and in streams and stream banks. This will reduce animal waste deposition and heavy traffic areas near streams to more upland locations. This practice works in conjunction with the practice of stream protection with fencing. An assessment of acres for off-stream watering is based on a GIS analysis of a cattle farm in the watershed.

3.4.2 Nutrient Management Plans

Nutrient management plan (NMP) implementation refers to a comprehensive plan that describes the optimal use of nutrient inputs for crop yield to minimize loss of excess nutrients to the environment. It is a requirement through the Maryland Water Quality Improvement Act of 1998 for farmers to meet specific requirements in their operations. A NMP details the type, rate, timing, and placement of nutrients for each crop. Soil, plant tissue, manure and/or sludge tests are used to assure optimal application rates. Plans are prepared by either University of Maryland Extension or certified private consultants, and are typically revised every year but may be written for up to three years to incorporate management, fertility and technology changes. Data on the number of NMPs in Loch Raven East was obtained from the Maryland Department of Agriculture.

3.4.3 Prescribed Grazing

This practice utilizes a range of pasture management and grazing techniques to improve the quality and quantity of the forages grown on pastures and reduce the impact of animal travel lanes, animal concentration areas or other degraded areas. Prescribed grazing can be applied to pastures intersected by streams or upland pastures outside of the degraded stream corridor (35 feet width from top of bank). The benefits of prescribed grazing practices can be applied to pasture acres in association with or without alternative watering facilities. They can also be applied in conjunction with or without stream access control. Pastures under the prescribed grazing systems are defined as having a vegetative cover of 60% or greater.

3.5 Pollutant Loading

This section presents results of the watershed pollutant loading analysis performed to estimate current nutrient loads generated by the various non-point sources within the Loch Raven East watershed. Also discussed are the pollutant removal calculations for proposed BMPs in Loch Raven East to help determine if TMDL requirements will be met for the Loch Raven Reservoir.

3.5.1 Pollutant Loading Analysis

A pollutant loading analysis was performed to estimate total nitrogen, phosphorus and sediment loads currently generated by all non-point sources (i.e. runoff from all land uses) present within the Loch Raven East watershed. Estimates were based on Maryland Department of Planning's (MDP) 2010 Land Use/Land Cover (LU/LC) GIS layer and pollutant loading rates based on the following sources: technical guidance provided by the Maryland Department of the Environment's (MDE) User's Guide for Nutrient Load Analysis Spreadsheet in Support of the Water Resources Element (WRE), and the Chesapeake Bay Program (CBP) – Watershed Model Phase 5.3.2 (CBP, 1998). It is widely assumed that the sediment reductions will be met through the phosphorus reduction goal (i.e., phosphorus associated with sediment particles). Further, the sediment TMDL for Loch Raven addresses reservoir capacity rather than water quality. Urban pervious and impervious nutrient and sediment loading rates are from Baltimore County and derived as watershed-specific pollutant loading rates for nitrogen, phosphorus and sediment based on the Maryland Assessment and Scenario Tool in October 2011. The pollutant loading analysis is described in detail in Chapter 3.3 of the Watershed Characterization Report (Appendix E). Table 3-1 provides a summary of the results from the watershed pollutant loading analysis including areas, nutrient and sediment loading rates, and annual nutrient and sediment loads for each nonpoint source/land use type. It should be noted that agricultural and forested land area associated with the WRE large lot subdivision land use is included in land acres shown in Table 3-1.

Table 3-1: Total Annual Nutrient and Sediment Loads from Loch Raven East

WRE Land Cover		Nitrogen		Phosphorus		Sediment	
	Area (Acres)	Rate (lbs/acres/yr)	Load (lbs/yr)	Rate (lbs/acres/yr)	Load (lbs/yr)	Rate (lbs/acres/yr)	Load (lbs/yr)
Cropland	1,352	23.08	31,193	1.32	1,781	1,111.17	1,502,308
Forest	4,639	2.77	12,871	0.04	182	64.37	298,596
Pasture/Orchards/Ag. Building	1,119	7.76	8,677	0.72	800	277.63	310,669
Impervious Urban	561	17.35	9,739	1.51	849	1,601.41	898,389
Pervious Urban	3,741	11.55	43,201	0.3	1,110	220.64	825,398

WRE Land Cover		Nitrogen		Phosphorus		Sediment	
Livestock	0	162.74	0	23.92	0	4,099.73	0
Water	156	10.26	1,604	0.61	95	0	0
Septic Systems	--	8.92	21,409	--	--	--	--
Total	11,568		128,694		4,817		3,835,359

As discussed in Chapter 1, the TMDL goal for total phosphorus in the Loch Raven Watershed is a reduction of 50%. In Loch Raven East, the total phosphorus urban load is 1,959 pounds and 2,858 pounds for the agriculture load. To achieve the total phosphorus TMDL target, a total of 2,409 pounds must be reduced. Although there isn't a local TMDL for total nitrogen in Loch Raven East, the Chesapeake Bay TMDL will allocate a load reduction for total nitrogen, total phosphorus and total suspended solids. Table 3-2 provides a summary of the total phosphorus and total nitrogen loads for the Loch Raven East watershed based on loading rates in Table 3-1.

Table 3-2: Loch Raven East Total Phosphorus, Nitrogen and Sediment Load Reduction Requirements

Area (Acres)	Total Phosphorus (lbs/yr)	Total Phosphorus Source	Total Nitrogen (lbs/yr)	Total Nitrogen Source	Total Sediment (lbs/yr)	Total Sediment Source
11,567	4,817	Urban, Agriculture and Forest	128,694	Urban, Agriculture, Forest and Septic Systems	3,835,359	Urban, Agriculture and Forest
50% TP Reduction:	2,409		0			
25% TS Reduction:			0		958,840	

There are no monitoring stations for bacteria in Loch Raven East. A one-year period of monitoring will be conducted in the subwatersheds to determine if bacteria levels are elevated in these areas. If unacceptable levels are found, a bacteria remediation plan will be established within one year.

3.6 Pollutant Removal Analysis

This section presents a quantitative analysis of pollutant removal capabilities of existing and proposed BMPs to determine if the 50 percent reduction in total phosphorus loads from Loch Raven East can be achieved. Note that many of the removal efficiencies used to estimate pollutant reductions are based on the Phase 5.3 CBP Watershed Model efficiencies that are provided in Appendix D. Also note that the calculations and estimates presented in the following subsections represent maximum potential pollutant removal capabilities. A summary of overall pollutant load reduction estimates is presented at the end of this section.

3.6.1 Existing Urban Stormwater Management (SWM)

As described in detail in Section 2.3.6 of the *Watershed Characterization Report* (Appendix E), there are 27 existing SWM facilities in Loch Raven East including detention ponds, infiltration/filtration practices and extended detention ponds. The pollutant loading analysis included in Appendix E did not account for the existing SWM practices in the watershed. The pollutant load reduction from existing SWM practices are taken into account as part of this analysis. Pollutant reductions for existing SWM are calculated using one of two methods, depending on whether the drainage area (DA) to the facility has been digitized in GIS. All 27 of the Loch Raven East facilities have had their drainage areas digitized, and therefore actual pollutant loads from the drainage areas can be modeled. Removal efficiencies used for all facilities are those recommended by CBP for the various types of SWM facilities. The equation used to estimate total nitrogen (TN) load reductions for a particular type of SWM facility is expressed as:

$$[13.15 \text{ (lbs/ac/yr)} \times \text{DA (acres)}] \times \text{efficiency (\%)}$$

The equation used to estimate total phosphorus (TP) load reductions for a particular type of SWM facility is expressed as:

$$[0.65 \text{ (lbs/ac/yr)} \times \text{DA (acres)}] \times \text{efficiency (\%)}$$

The pollutant load received from the drainage area contributing to the SWM facility is denoted by the first expression in brackets in both of the above equations. The pollutant loading rates shown represent the weighted average of impervious and pervious urban rates used in the pollutant loading analysis since this represents the likely sources of runoff being treated by SWM. The total pollutant load reduction expected from existing SWM is a sum of the removal capacities of the individual facilities. A summary of existing SWM load reduction calculations and results are shown in Table 3-3.

Table 3-3: SWM Load Reductions

SWM Facility Type	Number of BMPs	Drainage Area (Acres)	TN Load from Drainage Area (lbs/yr)	TN Removal Efficiency (%)	Max. Potential TN Load Reduction (lbs/yr)	TP Load from Drainage Area (lbs/yr)	TP Removal Efficiency (%)	Max. Potential TP Load Reduction (lbs/yr)
Detention	5	16.5	217.0	5%	10.9	10.7	10%	1.1
Extended Detention	5	79.1	1,040.2	20%	208.0	51.4	20%	10.3
Filtration	14	146.1	1,921.2	40%	768.5	95.0	60%	57.0
Infiltration	3	4.5	59.2	80%	47.4	2.9	85%	2.5
Totals	27	246.2	3,237.5		1,034.8	160.0		70.9

3.6.2 Agricultural Best Management Practices

As described in Section 2.3 of the *Watershed Characterization Report* (Appendix E), 17.5% of Loch Raven East consists of agricultural land use that includes cropland and pasture/orchards/agricultural buildings. This percentage increases to 21.4% if agricultural land associated with large lot subdivision is included in this acreage (Table 3-1). There is considerable acreage in Loch Raven East currently being treated by five different agricultural BMPs. The information on the extent of treatment and type of BMP was provided by Baltimore County Department of EPS and SCD staff.

In the future, any additional agricultural acreage put into a Soil Conservation and Water Quality Plan (SCWQP) or Nutrient Management Plan (NMP) will be credited toward the nutrient reduction goal.

Soil Conservation and Water Quality Plans

According to the Maryland Department of Agriculture's Conservation Tracker System, there were 25 existing SCWQP within Area R covering 885.0 acres. As described in Chapter 5 of the *Watershed Characterization Report* (Appendix E), a SCWQP is a comprehensive plan that addresses natural resource management on agricultural lands and describes BMPs which will be used to control erosion and sediment loss and manage runoff. The pollutant removal capability of existing SCWQPs in the watershed is accounted for in the pollutant removal analysis. Pollutant reductions for the implementation of a SCWQP are calculated based on the acres of agricultural land managed under a SCWQP and the reduction efficiency of a conservation plan based on the Baltimore County Agricultural Reduction summary table (Appendix D). The equation used to estimate total nitrogen (TN) load reductions for a SCWQP is expressed as:

$$0.93 \text{ (lbs/ac/yr) x SCWQP area (acres)}$$

The equation used to estimate total phosphorus (TP) load reductions for a SCWQP is expressed as:

$$0.14 \text{ (lbs/ac/yr) x SCWQP area (acres)}$$

A summary of SCWQP load reduction calculations and results is shown in Table 3-4.

Table 3-4: SCWQP Load Reductions

Pollutant	Agriculture Reduction Rate (lbs/ac/yr)	SCWQP (acres)	Max. Potential Load Reduction (lbs/yr)
TN	0.93	885	823.1
TP	0.14	885	123.9

Streamside Forest Buffer

Riparian buffers are wooded areas along rivers and streams that help filter nutrients, sediments and other pollutants from runoff and groundwater and help reduce erosion. The equation used to estimate total nitrogen (TN) load reductions for riparian buffers is expressed as:

28.72 (lbs/acre/yr) x streamside forest buffers (acres)

The equation used to estimate total phosphorus (TP) load reductions for streamside forest buffers is expressed as:

1.94 (lbs/acre/yr) x streamside forest buffers (acres)

The estimate of 8.8 acres of existing buffer in the watershed was provided by Baltimore County Soil Conservation District. A summary of load reduction calculations and results are shown in Table 3-5.

Table 3-5: Streamside Forest Buffer Load Reductions

Pollutant	Agriculture Reduction Rate (lbs/ac/yr)	SCWQP (acres)	Max. Potential Load Reduction (lbs/yr)
TN	28.72	8.8	252.7
TP	1.94	8.8	17.1

Off-Stream Watering

Off-stream watering provides cattle an alternative drinking water source away from streams. By providing an off-stream watering source, cattle will reduce the time they spend near and in streams and stream banks. The equation used to estimate total nitrogen (TN) load reductions for off-stream watering is expressed as:

3.4 (lbs/acre) x stream protection area (acres)

The equation used to estimate total phosphorus (TP) load reductions for off-stream watering is expressed as:

0.46 (lbs/acre) x stream protection area (acres)

The estimate of 4.0 acres of off-stream watering in the watershed was provided by Baltimore County Soil Conservation District. A summary of load reduction calculations and results are shown in Table 3-6.

Table 3-6: Off-Stream Watering Load Reductions

Pollutant	Agriculture Reduction Rate (lbs/ac/yr)	SCWQP (acres)	Max. Potential Load Reduction (lbs/yr)
TN	3.4	4.0	13.6
TP	0.46	4.0	1.8

Nutrient Management Plans

Nutrient Management Plans (NMP) refers to a comprehensive plan that describes the optimal use of nutrient inputs for crop yield to minimize loss of excess nutrients to the environment. One NMP was reported by the Maryland Department of Agriculture on 166.3 acres of agricultural land in Loch Raven East. Pollutant reduction for the implementation of a NMP are calculated based on the acres of agricultural land managed under a NMP, and NMP reduction efficiency provided in the Baltimore County Agricultural Reduction summary table (Appendix D). The equation used to estimate total nitrogen (TN) load reductions for a NMP is expressed as:

3.11 (lbs/ac) x NMP area (acres)

The equation used to estimate total phosphorus (TP) load reductions for a NMP is expressed as:

0.30 (lbs/ac) x NMP area (acres)

The reduction in pollutant loading rates, 3.11 lbs/ac of TN and 0.30 lb/ac of TP represent nutrient reductions based on Baltimore County Agricultural Reduction summary table shown in Appendix D. A summary of NMP load reduction calculations and results are shown in Table 3-7.

Table 3-7: Nutrient Management Plan Load Reductions

Pollutant	Agricultural Reduction Rate (lbs/ac/yr)	NMP (acres)	Max. Potential Load Reduction (lbs/yr)
TN	3.11	166.3	517.2
TP	0.30	166.3	49.9

Prescribed Grazing

Prescribed grazing is a BMP designed to improve forages grown on pastures and reduce the impact of livestock. The equations used to estimate load reductions for prescribed grazing is based on the loading rate for pasture land and a removal efficiency from the Baltimore County Agricultural Reduction summary table shown in Appendix D. For total nitrogen (TN), the equation is:

7.76 (lbs/acre/yr) x 9% x prescribed grazing area (acres)

The equation used to estimate total phosphorus (TP) load reductions for prescribed grazing is expressed as:

0.72 (lbs/acre/yr) x 24% x prescribed grazing area (acres)

A summary of NMP load reduction calculations and results are shown in Table 3-8.
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Table 3-8: Existing Prescribed Grazing Load Reductions

Pollutant	Pasture Loading Rate (lb/ac/yr)	Agricultural Reduction Rate (percent)	Prescribed Grazing (acres)	Max. Potential Load Reduction (lbs/yr)
TN	7.76	9%	10.6	7.4
TP	0.72	24%	10.6	1.8

3.6.3 Proposed Urban Restoration Practices

Stormwater Retrofits

Proposed stormwater retrofits for the purposes of this SWAP refer to implementing BMPs to capture and treat runoff from impervious surfaces (i.e., streets, parking lots) which are currently untreated. While specific types of stormwater retrofit practices were not identified, sites were noted for retrofit potential during the uplands surveys for neighborhoods and included cul-de-sacs, roadway medians, and swales (Appendix E, Chapter 4). Conversion potential of existing facilities were not completed as part of this SWAP. Pollutant reductions for stormwater retrofits are calculated based on the approximate pollutant load received from the impervious drainage area (DA) and a removal efficiency typical of infiltration type BMPs with underdrains. The equation used to estimate total nitrogen (TN) load reductions for stormwater retrofits is expressed as:

$$[17.35 \text{ (lbs/ac/yr)} \times \text{DA (acres)}] \times 62\%$$

The equation used to estimate total phosphorus (TP) load reductions for stormwater retrofits is expressed as:

$$[1.51 \text{ (lbs/ac/yr)} \times \text{DA (acres)}] \times 70\%$$

The pollutant load received from the drainage area contributing to the proposed SWM facility is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 17.35 lbs TN/ac/yr and 1.51 lbs TP/ac/yr, are the impervious urban rates used in the pollutant loading analysis (Table 3.1) since this represents the source of runoff being treated. Pollutant removal efficiencies are those reported for infiltration practices based on the CBP guidance shown in Appendix D under Urban BMPs. A summary of stormwater retrofit load reduction calculations and results are shown in Table 3-9.

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Table 3-9: Stormwater Retrofit (SW, Infiltration Practices) Load Reductions

Pollutant	Impervious Urban Loading Rate (lbs/ac/yr)	Impervious Area for SW Retrofits (acres)	Load from DA (lbs/yr)	Estimated RSC (Wet) Length (ft)	Removal Efficiency	Max. Potential Load Reduction (lbs/yr)
Bioretention (no underdrain)						
TN[1]	17.35	10.7	185.1		62%	115.4

Pollutant	Impervious Urban Loading Rate (lbs/ac/yr)	Impervious Area for SW Retrofits (acres)	Load from DA (lbs/yr)	Estimated RSC (Wet) Length (ft)	Removal Efficiency	Max. Potential Load Reduction (lbs/yr)
TP[2]	1.51	10.7	16.1		70%	11.3
Grass Swale						
TN	17.35	0.7	11.3		70%	7.9
TP	1.51	0.7	1.0		75%	0.7
Regenerative Stormwater Conveyance (Dry)						
TN[1]	17.35	0.7	12.3		62%	7.7
TP[2]	1.51	0.7	1.1		70%	0.7
Regenerative Stormwater Conveyance (Wet)						
TN	17.36	8.2	142.7	431.8	0.200 lb/ft	86.4
TP	1.51	8.2	12.4	431.8	0.068 lb/ft	29.4

[1]Removal efficiency pro-rated based on the hydrologic soil group (HSG) percentage 83% "B" (removal efficiency of 70%) and 17% "C" (removal efficiency of 25%)
[2] Removal efficiency prorated based on HSG percentage 83% "B" (removal efficiency of 75%) and 17% "C" (removal efficiency of 45%)

Stream Corridor Restoration

Stream corridor restoration practices are used to enhance the appearance, stability, and aquatic function of stream corridors. Practices include simple stream stabilization (including vegetative bank stabilization and grade control) and stream restoration (including redesign and re-alignment). Similar projects such as the Minebank Run stream restoration have been successfully completed by Baltimore County. Several potential stream restoration sites were identified during the stream corridor assessments (See Appendix E, Chapter 3) to improve water quality and address stream stability issues, such as significant erosion and channel alterations. Pollutant reductions for stream corridor restoration are calculated based on the load reduction factors provided by CBP (Appendix D) multiplied by the linear feet of identified significant erosion, and channel alteration sites. The equation used to estimate total nitrogen (TN) load reductions for stream corridor restoration is expressed as:

$$0.2 \text{ (lbs/ft)} \times \text{stream corridor length (ft)}$$

The equation used to estimate total phosphorus (TP) load reductions for stream corridor restoration is expressed as:

$$0.068 \text{ (lbs/ft)} \times \text{stream corridor length (ft)}$$

The analysis is based on the stream corridor assessments (SCA) and the 1997 Water Quality Management Plan that identified a total of 7,791 linear feet of erosion recommended for stream restoration. A total of 2,140 linear feet of restoration are located within Fitzhugh Run from the 1997 plan and 5,381 linear feet are based on the SCA in Dulaney Valley Branch. A summary of stream restoration calculations and results are shown in Table 3-10.

Table 3-10: Stream Corridor Restoration Load Reductions

Pollutant	Reduction in Loading Rate (lbs/ft/yr)	Estimated Stream Restoration Length (ft)	Max. Potential Load Reduction (lbs/yr)
TN	0.2	7,791	1,558.2
TP	0.068	7,791	529.8

Urban Stream Buffer Reforestation

The current vegetative condition of the urban stream riparian buffer (100 feet on either side of the stream system) was identified during the stream assessment in 1997 and 2012. In addition, buffer conditions were classified as impervious, open pervious or forested areas (Appendix E, Chapter 2). Open pervious areas are the best areas to initially target for restoration. Pollutant reductions for stream buffer reforestation are calculated based on a land use conversion from pervious urban to forest plus an additional reduction efficiency based on BMP performance guidance from CBP (Appendix D). The equation used to estimate the total nitrogen (TN) load reduction for the land use conversion portion of stream buffer reforestation is expressed as:

Land Use Conversion (TN) = [11.55 (lbs/ac/yr) – 2.77 (lbs/ac/yr)] x Open Buffer Area (acres)

The equation used to estimate total phosphorus (TP) load reductions for the land use conversion portion of stream buffer reforestation is expressed as:

Land Use Conversion (TP) = [0.30 (lbs/ac/yr) – 0.04 (lbs/ac/yr)] x Open Buffer Area (acres)

The first expression in brackets in the equations above represents the difference between pervious urban and forest loading rates used in the watershed pollutant loading analysis. This reduction in loading rate is then multiplied by the available open pervious area for reforestation to determine the load reductions from land use conversion. An additional pollutant removal factor is added to the land use conversion to determine the total removal capacity of buffer reforestation. Based on the BMP performance guidance in Appendix D, one acre of buffer treats one acre of upland area with a TN reduction efficiency of 25% for forest buffers. The TN load reductions for the removal efficiency portion of buffer reforestation can be expressed as:

Buffer BMP Removal (TN) = [Open Buffer Area (acres) x 11.13 (lbs/ac/yr)] x 25%

Similarly, an efficiency of 50% for TP for buffers is applied to the buffer acreage being reforested. The TP load reductions for the removal efficiency portion of buffer reforestation can be expressed as:

Buffer BMP Removal (TP) = [Open Buffer Area (acres) x 0.42 (lbs/ac/yr)] x 50%

The loading rates shown in the equations above, 11.13 lbs/ac/yr TN and 0.42 lbs/ac/yr TP represent the overall watershed loading rates. This is estimated as the total watershed nutrient load (128,694 lbs/yr TN and 4,817 lbs/yr TP) divided by the total watershed area (11,568 acres). These are used to calculate the pollutant load from the upland area that would be treated by buffer reforestation. There are 770 acres of open pervious area identified (see Appendix E, Section 2.2.7.2), which was reduced by 17.5 acres available for agricultural stream buffer restoration for a total of 752.5 acres. As mentioned, the land use conversion and additional removal efficiency are added to yield a total pollutant load reduction. A summary of stream buffer reforestation reduction calculations and results are shown in Table 3-11.

Table 3-11: Stream Buffer Reforestation Load Reductions

		Land Use Conversion		Buffer BMP Removal			
Pollutant	Open Pervious Area (acres)	Reduced Loading Rate (lbs/ac/yr)	Land Use Conversion Reduction (lbs/yr)	Reduction Efficiency (%)	Overall Watershed Loading Rate (lbs/ac/yr)	Efficiency Load Reduction (lbs/yr)	Max. Potential Load Reduction (lbs/yr)
TN	752.5	8.78	6,607.3	25%	11.13	2,093.0	8,700.3
TP	752.5	0.26	195.7	50%	0.42	156.7	352.3

Institutional Tree Plantings

None of the neighborhoods were identified for street tree planting or open space shade trees. However, tree planting opportunities were identified at many institutional sites. The number of trees to be planted was estimated based on 200 trees per acre. Pollutant reductions for pervious area reforestation are calculated based on a land use conversion from pervious urban to forest. An approximation of 200 trees per acre is used to calculate the converted acreage. The equation used to estimate TN load reductions for tree plantings is expressed as:

[11.55 (lbs/ac/yr) – 2.77 (lbs/ac/yr) x [# Trees x 1(acre)/200(trees)]

The equation used to estimate TP load reductions for tree plantings is expressed as:

[0.30 (lbs/ac/yr) – 0.04 (lbs/ac/yr) x [# Trees x 1(acre)/200(trees)]

Tree plantings would involve converting open pervious area to forest. Therefore, the loading rate would be reduced by a factor equal to the difference between pervious urban and forest loading rates used in the watershed pollutant loading analysis, as shown in the first expression in brackets in the equations above. The approximate reduction in pollutant load is the loading rate reduction multiplied by the open pervious area available for reforestation (i.e., the expression in the second brackets in the equations above). A summary of tree planting load reduction calculations and results are shown in Table 3-12.

Table 3-12: Institution Tree Planting Load Reductions

Pollutant	Pervious Urban Loading Rate (lbs/ac/yr)	Forest Loading Rate (lbs/ac/yr)	Reduced Loading Rate (lbs/ac/yr)	Estimated # Trees for ISIs (#)	New Forested Area (acres)	Max. Potential Load Reduction (lbs/yr)
TN	11.55	2.77	8.78	460	2.3	20.2
TP	0.30	0.04	0.26	460	2.3	0.6

Urban Nutrient Management – Maryland Fertilizer Use Act of 2011

The State of Maryland recently passed the Maryland Fertilizer Use Act of 2011 (the Act) that took effect in October 2013. The Act bans phosphorus and provides a greater percentage of slow release nitrogen in fertilizer. The fertilizer bags have better labeling and lawn care professionals are required to be certified in proper fertilizer application. The Chesapeake Bay Program Urban Nutrient Management Expert Panel Report recommendations include TN reductions of 9 percent for commercial applicators of fertilizer and 4.5 percent for “do-it yourself” fertilizer applicators for the State of Maryland (Schueler and Lane, 2013). A 25% reduction is given to TP for urban nutrient management. In Area R, this reduction will apply to an estimated 2,594 acres of residential parcels (lawns), and 466.44 acres of non-residential parcels (pervious area of the golf course, open urban areas, and commercial areas). Pollutant reductions applied for the Act are calculated based on the urban pervious pollutant load multiplied by the acres of managed turf, then the pollutant reduction efficiency. The equation used to estimate total nitrogen (TN) load reductions for commercial applicators, or non-residential parcels is expressed as:

[11.55 (lbs/acre/yr) x managed turf (acres)] x 9%

The equation used to estimate total nitrogen (TN) load reductions for residential applicators, or non-residential parcels is expressed as:

[11.55 (lbs/acre/yr) x managed turf (acres)] x 4.5%

The equation used to estimate total phosphorus (TP) load reductions for the Act reduction is expressed as:

[0.30 (lbs/acre/yr) x managed turf (acres)] x 25%

The pollutant load received from the urban pervious area that the Act will be applied to is denoted by the first expression in brackets in the equations above. The pollutant loading rates shown, 11.55 lbs/ac/yr of TN and 0.30 lbs/ac/yr of TP, are the pervious urban rates used in the pollutant loading analysis. Pollutant removal efficiencies are those reported by the State to be applied from the Act. A summary of fertilizer load reduction calculations and results are shown in Table 3-13.

Table 3-13: Maryland Fertilizer Use Act of 2011 Load Reductions

Pollutant	Pervious Urban Loading Rate (lbs/ac/yr)	Acres of Managed Turf (ac)	Removal Efficiency (%)	Max. Potential Load Reduction (lbs/yr)
TN (Residential)	11.55	2,594.6	4.5	1,348.5
TN (Non-residential)	11.55	466.4	9	484.8
TP	0.30	3,061	25	229.6

3.6.4 Proposed Agricultural Restoration Practices

One of the key parameters for estimating load reductions from any BMP or restoration practice is the area which will be treated by that practice. For urban BMPs, this is generally estimated by delineating the drainage to a particular structural BMP or estimating the area that will be restored, e.g. acres of tree planting or buffer restoration. For all of the agricultural BMPs except streamside forest buffer, the specific location of a potential treatment may not be known, so an alternative method of estimating the area must be used. The proposed treated area for the BMPs within this section was estimated by pro-rating the Bay TMDL Phase II WIP goal for the 94,678 acres of agriculture in the county to the 2,471 agricultural acres of Loch Raven East, resulting in a factor of 2.6%. Once the acreage of the goal was determined, the existing area of treatment was subtracted, giving the proposed new area to be treated by each practice. Table 3-14 shows the results of load reductions that may be achieved from agriculture restoration practices. A description of the individual practices is described in the following sections.

Table 3-14: Treated Area for Agricultural Restoration

Practice	Existing Area (ac)	County-Wide WIP II 2025 Goal (ac)	Pro-Rated Goal (ac)	Additional Area to be Treated (ac)
SCWQP	885.0	42,846.0	1,118.2	233.2
Streamside Forest Buffer	8.8	331.7	17.5	8.7
Off-Stream Watering Facility	4.0	600.0	15.7	11.7
Stream Protection / Fencing	0.0	94.6	2.5	2.5
Nutrient Mgmt Plans	166.3	10,710.5	279.5	113.2
Prescribed Grazing	10.6	1,000.0	26.1	15.5

Soil Conservation and Water Quality Plans

A Soil Conservation and Water Quality Plan (SCWQP) is a comprehensive plan that addresses natural resource management on agricultural lands and describes BMPs which will be used to control erosion and sediment loss and manage runoff. Nutrient reduction credits are applied for the overall acreage brought under SCWQP, as well as credits for individual BMPs developed as part of the plan. The equation used to estimate total nitrogen (TN) load reductions for a SCWQP is expressed as:

$$0.93\ (\text{lbs/ac/yr}) \times \text{SCWQP area (acres)}$$

The equation used to estimate total phosphorus (TP) load reductions for a SCWQP is expressed as:

$$0.14\ (\text{lbs/ac/yr}) \times \text{SCWQP area (acres)}$$

A summary of SCWQP load reduction calculations and results is shown in
Table 3-15.

Table 3-15: SCWQP Load Reductions

Pollutant	Agriculture Reduction Rate (lbs/ac/yr)	SCWQP (ac)	Max. Potential Load Reduction (lbs/yr)
TN	0.93	233.2	216.9
TP	0.14	233.2	32.6

Streamside Forest Buffers

The current vegetative condition of the agricultural stream riparian buffer (100 feet on either side of the stream system) was identified during the stream assessment in 1997 and 2012. In addition, buffer conditions were classified as impervious, open pervious or forested areas. Open pervious areas are the best areas to initially target for restoration. Pollutant reductions for agricultural streamside forest buffers are calculated based on the load reduction provided by Baltimore County Agricultural load reduction summary table shown in Appendix D, multiplied by the acres of open pervious land available for conversion to streamside forest buffers. The equation used to estimate total nitrogen (TN) load reductions for streamside forest buffers is expressed as:

$$28.72\ (\text{lbs/acre}) \times \text{streamside forest buffers (acres)}$$

The equation used to estimate total phosphorus (TP) load reductions for streamside forest buffers is expressed as:

$$1.94\ (\text{lbs/acre}) \times \text{streamside forest buffers (acres)}$$

The analysis is based on the pro-rated area of stream buffers available to be converted to forest buffers on agricultural lands. A summary of agricultural streamside forest buffer calculations and results are shown in Table 3-16.

Table 3-16: Agricultural Streamside Forest Buffer Load Reductions

Pollutant	Agriculture Reduction Rate (lbs/ac)	Estimated Agricultural Streamside Forest Buffer Area (ac)	Max. Potential Load Reduction (lbs/yr)
TN	28.72	8.7	249.9
TP	1.94	8.7	16.9

Stream Protection with Fencing

Stream protection with fencing to exclude cattle from the stream was identified as a recommendation at a farm in the watershed. The fence would enclose a 50 foot streamside buffer adjacent to the stream for a total of 2.5 acres. Pollutant reductions for streamside fencing are calculated based on the load reduction provided by Baltimore County Agricultural Reduction summary table shown in Appendix D, multiplied by the acres of land protected along the stream with fencing. The equation used to estimate total nitrogen (TN) load reductions for streamside fencing is expressed as:

$$6.79 \text{ (lbs/acre)} \times \text{stream protection area (acres)}$$

The equation used to estimate total phosphorus (TP) load reductions for streamside fencing is expressed as:

$$0.91 \text{ (lbs/acre)} \times \text{stream protection area (acres)}$$

A summary of agricultural streamside fencing calculations and results are shown in Table 3-17.

Table 3-17: Agricultural Streamside Fencing Load Reductions

Pollutant	Agriculture Reduction Rate (lbs/ac)	Estimated Agricultural Streamside Fencing Area (ac)	Max. Potential Load Reduction (lbs/yr)
TN	6.79	2.5	17.0
TP	0.91	2.5	2.3

Off-Stream Watering

Off-stream watering provides cattle an alternative drinking water source away from streams. By providing an off-stream watering source, cattle will reduce the time they spend near and in streams and stream banks. This will reduce animal waste deposition and heavy traffic areas near streams and divert associated impacts to more upland locations. This practice works in conjunction with the practice of stream protection with fencing. Pollutant reductions for off-stream watering are calculated based on the load reduction provided by Baltimore County Agricultural Reduction summary table shown in Appendix D, multiplied by the acres of land on the livestock farm in the watershed (11.7 acres). The equation used to estimate total nitrogen (TN) load reductions for off-stream watering is expressed as:

3.4 (lbs/acre) x stream protection area (acres)

The equation used to estimate total phosphorus (TP) load reductions for off-stream watering is expressed as:

0.46 (lbs/acre) x stream protection area (acres)

A summary of agricultural off-stream watering calculations and results are shown in Table 3-18.

Table 3-18: Agricultural Off-Stream Watering Load Reductions

Pollutant	Agriculture Reduction Rate (lbs/ac)	Estimated Agricultural Off-Stream Watering (ac)	Max. Potential Load Reduction (lbs/yr)
TN	3.40	11.7	39.8
TP	0.46	11.7	5.4

Nutrient Management Plans

Nutrient management plan (NMP) implementation refers to a comprehensive plan that describes the optimum use of nutrient inputs for crop yield to minimize loss of excess nutrients to the environment. The equation used to estimate total nitrogen (TN) load reductions for a NMP is expressed as:

3.11 (lbs/ac) x NMP area (acres)

The equation used to estimate total phosphorus (TP) load reductions for a NMP is expressed as:

0.30 (lbs/ac) x NMP area (acres)

The reduction in pollutant loading rates, 3.11 lbs/ac of TN and 0.30 lb/ac of TP represent nutrient reductions provided by Baltimore County Agricultural Reduction summary table shown in Appendix D. A summary of NMP load reduction calculations and results are shown Table 3-19.

Table 3-19: Nutrient Management Plan Load Reductions

Pollutant	Agricultural Reduction Rate (lbs/ac/yr)	NMP (ac)	Max. Potential Load Reduction (lbs/yr)
TN	3.11	113.2	352.1
TP	0.30	113.2	34.0

Prescribed Grazing

Prescribed grazing is a BMP designed to improve forages grown on pastures and reduce the impact of livestock. The equations used to estimate load reductions for prescribed grazing are based on the loading rate for pasture land and a removal efficiency from the Baltimore County Agricultural Reduction summary table shown in Appendix D. For total nitrogen (TN), the equation is:

7.76 (lbs/acre/yr) x 9% x prescribed grazing area (acres)

The equation used to estimate total phosphorus (TP) load reductions for prescribed grazing is expressed as:

0.72 (lbs/acre/yr) x 24% x prescribed grazing area (acres)

A summary of prescribed grazing load reduction calculations and results are shown in Table 3-20.

Table 3-20: Existing Prescribed Grazing Load Reductions

Pollutant	Pasture Loading Rate (lb/ac/yr)	Agricultural Reduction Rate (percent)	Prescribed Grazing (acres)	Max. Potential Load Reduction (lbs/yr)
TN	7.76	9%	15.5	10.8
TP	0.72	24%	15.5	2.7

3.6.5 Overall Pollutant Load Reductions

The sum of the maximum potential pollutant load reductions calculated for individual BMPs represents the overall pollutant removal capacity for a maximum implementation scenario. The maximum load reduction assumes 100% of the projects are implemented. This scenario provides a starting point to evaluate the type and extent of implementation needed to meet the required 50% total phosphorus TMDL load reduction goal. Table 3-21 provides a description of existing and proposed BMPs applied to this scenario.

Table 3-21: Projected Participation Factors

BMP	Projected Participation	Basis of Assumption
Urban		
Existing Detention	n/a	Existing – BMPs already implemented
Existing Extended Detention	n/a	Existing – BMPs already implemented
Existing Filtration	n/a	Existing – BMPs already implemented
Existing Infiltration	n/a	Existing – BMPs already implemented
Bioretention (no underdrain)	50%	Install retrofits for 10.7 acres of impervious cover
Grass Swale	50%	Install retrofits for 0.7 acres of impervious cover

BMP	Projected Participation	Basis of Assumption
Regenerative Stormwater Conveyance (Dry)	50%	Install retrofits for 0.7 acres of impervious cover
Regenerative Stormwater Conveyance (Wet)	75%	Install retrofits for 431.8 linear feet of RSC
Stream Corridor Restoration	75%	Restore 7,791 linear feet of stream
Stream Buffer Reforestation	10%	Convert 752.5 acres from open pervious to forest land use
Institutional Tree Planting	50%	Plant 460 trees in two locations
Maryland Fertilizer Use Act of 2011	100%	Act implemented in 2013
Agricultural		
Existing Soil Conservation and Water Quality Plan	n/a	Existing – BMPs already implemented
Existing Riparian Forest Buffer	n/a	Existing – BMPs already implemented
Existing Off-Stream Watering Facilities	n/a	Existing – BMPs already implemented
Existing Nutrient Management Plan	n/a	Existing – BMPs already implemented
Existing Prescribed Grazing	n/a	Existing – BMPs already implemented
Soil Conservation and Water Quality Plan	50%	Protect 233.2 acres
Riparian Forest Buffer	25%	Protect 8.7 acres of Riparian Forest Buffer areas
Stream Protection with Fencing	25%	Install fencing to protect 2.5 acres
Off-Stream Watering Facilities	25%	Reduce Off-stream Watering in 11.7 acres
Nutrient Management Plan	100%	Reduce Nutrient in 113.2 acres
Prescribed Grazing	50%	Reduce Grazing in 15.5 acres

Table 3-22 presents a summary of the maximum potential pollutant load reductions and the methods used to credit each BMP, pollutant removal efficiencies, number of BMPs available for restoration, and projected load reductions. For Loch Raven East, in order to reach the 50 percent reduction of TP load goal, it was assumed that 100% participation would be needed. The projected implementation of BMP restoration projects shown in Table 3-22estimates a TP reduction of 1,513.6 lb/yr of the 4,817 lb/yr TP load, or 31.4%. The load reduction estimate for the Loch Raven East watershed will contribute to the 50 percent reduction of TP load needed to meet water quality standards for the watershed as a whole as specified by the TMDL (Appendix K). Additional BMP implementation in this watershed or in the other Loch Raven Reservoir watersheds is needed.

Additional reductions in the Loch Raven East watershed may be achieved as pollutant removal efficiencies for BMPs are changed from those currently defined by the CBP (Appendix D). Further TP load reductions may also be achieved through additional stream restoration projects in the subwatersheds not assessed as part of this SWAP or in the 1997 Water Quality Management Plan for the Loch Raven Reservoir. For example, if 4% of the linear feet is targeted for restoration in the other four subwatersheds, then an additional 718 lbs of TP may be reduced in Area R. The 4% target is based on the length of streams identified for restoration relative to total streams miles in Dulaney Valley Branch as part of the stream corridor assessments. This results in meeting 92.6% of the targeted TMDL load reduction for TP. Other restoration practices to consider include retrofitting existing stormwater management practices for urban land uses or streamside forest buffers. For agricultural land uses, supplemental acreages for streamside forest buffers and stream protection with fencing actions may be considered given their higher removal rates for TP compared to other agricultural actions.

The Chesapeake Bay Program is continuously reviewing the types and removal efficiencies for BMPs that may results in new BMPs or changes in pollutant load reductions that may be achieved with existing BMPs. The restoration practices identified in the SWAP should be revisited and adapted based on this information. For example, this analysis does not include public education/outreach efforts (e.g. pet waste pick-up, and septic system maintenance) which may be considered in the future.

Table 3-22: Summary of Maximum Pollutant Load Reduction Estimates

	BMP	How Credited	TN Efficiency	TP Efficiency	Max. Potential TN Load Reduction (lbs/yr)	Max. Potential TP Load Reduction (lbs/yr)	Units available	Unit	Projected TN Load Reduction (lbs/yr)	Projected TP Load Reduction (lbs/yr)
Urban										
Existing	Detention	Efficiency	5%	10%	10.9	1.1	16.5	acres	10.9	1.1
	Extended Detention	Efficiency	20%	20%	208.0	10.3	79.1	acres	208.0	10.3
	Filtration	Efficiency	40%	60%	768.5	57.0	146.1	acres	768.5	57.0
	Infiltration	Efficiency	80%	85%	47.4	2.5	4.5	acres	47.4	2.5
Proposed	Bioretention (no underdrain)	Efficiency	62%	70%	115.4	11.3	10.7	acres	115.4	11.3
	Grass Swale	Efficiency	70%	75%	7.9	0.7	0.7	acres	7.9	0.7
	Regenerative Stormwater Conveyance (Dry)	Efficiency	62%	70%	7.7	0.7	0.7	acres	7.7	0.7
	Regenerative Stormwater Conveyance (Wet)	Load Reduction Rate	N/A	N/A	86.4	29.4	431.8	ft	86.4	29.4
	Stream Corridor Restoration	Load Reduction Rate	0.2 (lbs/ft/yr)	0.068 (lbs/ft/yr)	1,558.2	529.8	7,791	ft	1,558.2	529.8

	BMP	How Credited	TN Efficiency	TP Efficiency	Max. Potential TN Load Reduction (lbs/yr)	Max. Potential TP Load Reduction (lbs/yr)	Units available	Unit	Projected TN Load Reduction (lbs/yr)	Projected TP Load Reduction (lbs/yr)
	Stream Buffer Reforestation	LU Conversion + Efficiency	8.78 (lbs/ac/yr) - 25.0%	0.26 (lbs/ac/yr) - 50.0%	8,700.3	352.3	752.5	acres	8,700.3	352.3
	Institutional Tree Planting	LU Conversion	8.78 (lbs/ft/yr)	0.26 (lbs/ft/yr)	20.2	0.6	460.0	trees	20.2	0.6
	Urban Nutrient Management	Efficiency	9% or 4.5%	25%	1,833.3	229.6	3,061	acres	1,833.3	229.6
Agricultural										
Existing	Soil Conservation and Water Quality Plan	Load Reduction Rate	0.93 (lbs/ac/yr)	0.14 (lbs/ac/yr)	823.1	123.9	885.0	acres	823.1	123.9
Existing	Riparian Forest Buffer	Load Reduction Rate	28.72 (lbs/ac/yr)	1.94 (lbs/ac/yr)	252.7	17.1	8.8	acres	252.7	17.1
Existing	Off-Stream Watering Facilities	Load Reduction Rate	3.4 (lbs/ac/yr)	0.46 (lbs/ac/yr)	13.6	1.8	4.0	acres	13.6	1.8
Existing	Nutrient Management Plan	Load Reduction Rate	3.11 (lbs/ac/yr)	0.3 (lbs/ac/yr)	517.2	49.9	166.3	acres	517.2	49.9
Existing	Prescribed Grazing	Load Reduction Rate	7.76 (lbs/ac/yr)	0.72 (lbs/ac/yr)	7.4	1.8	10.6	acres	7.4	1.8
Proposed	Soil Conservation and Water Quality Plan	Load Reduction Rate	0.93 (lbs/ac/yr)	0.14 (lbs/ac/yr)	216.9	32.6	233.2	acres	216.9	32.6
Proposed	Riparian Forest Buffer	Efficiency; Land Use Change	28.72 (lbs/ac/yr)	1.94 (lbs/ac/yr)	249.9	16.9	8.7	acres	249.9	16.9
Proposed	Stream Protection with Fencing	Land Use Change	6.79 (lbs/ac/yr)	0.91 (lbs/ac/yr)	16.8	2.2	2.5	acres	17.0	2.3
Proposed	Off-Stream Watering Facilities	Load Reduction Rate	3.4 (lbs/ac/yr)	0.46 (lbs/ac/yr)	39.8	5.4	11.7	acres	39.8	5.4
Proposed	Nutrient Management Plan	Land Use Change	3.11 (lbs/ac/yr)	0.3 (lbs/ac/yr)	352.1	34.0	113.2	acres	352.1	34.0

	BMP	How Credited	TN Efficiency	TP Efficiency	Max. Potential TN Load Reduction (lbs/yr)	Max. Potential TP Load Reduction (lbs/yr)	Units available	Unit	Projected TN Load Reduction (lbs/yr)	Projected TP Load Reduction (lbs/yr)
	Prescribed Grazing	Load Reduction Rate	9%	24%	10.8	2.7	15.5	acres	10.8	2.7
	Total Load Reduction (lbs/yr) :								15,864.5	1,513.6
	Total Existing Annual Load (lbs/yr) :								128,694.0	4,817.0
	Percent Load Reduction:								12.3%	31.4%

CHAPTER 4

Subwatershed Management Strategies

4.1 Introduction

This chapter describes the criteria and methodology used to rank the six subwatersheds within the Area R watershed based on restoration and protection potential. Although, restoration and protection actions will likely have to occur throughout the entire Area R in order to meet environmental goals and requirements, the subwatershed priority ranking provides a tool for targeting restoration and protection actions identified in Chapter 3 by subwatershed. This chapter also provides a summary for each subwatershed's characteristics, management strategies and implementation priorities. The recommendations were based on the county's 1997 Water Quality Management Plan for Loch Raven Reservoir Watershed, upland assessment data, available water quality and biological monitoring data, and agricultural data in the watershed. The restoration practices identified in Chapter 3 are also included in watershed-specific management strategies where a specific location (e.g. subwatershed) for the practice is identified to include for example stormwater retrofits, tree planting and stream restoration. Other restoration practices that are dispersed throughout the watershed are included in Appendix A as a general restoration action (e.g. Bayscaping, urban riparian buffer).

4.2 Subwatershed Prioritization

A ranking methodology was developed to prioritize subwatersheds in terms of restoration and protection need and potential. In general, a subwatershed is prioritized for restoration where able 3-8the subwatersheds are based on the data and analysis that characterize their environmental quality. As such, restoration and protection opportunities may target specific factors within the subwatershed. The following restoration and protection ranking criteria are:

Restoration Ranking Criteria

- Total Nitrogen and Total Phosphorus Loads
- Biological Indicators
- Impervious Surfaces
- Institutional Site Investigation

Protection Ranking Criteria

- Total Nitrogen and Total Phosphorus Loads
- Biological Indicators
- Impervious Surfaces
- Stream Buffer Improvement

Restoration Ranking Criteria

- Neighborhood Restoration Opportunity/Pollution Severity Indices
- Neighborhood Lawn Fertilization Reduction/Awareness
- Stream Buffer Improvement
- Septic Systems

Protection Ranking Criteria

- Agricultural Land

An ordinal ranking scale of 1 to 6 was used to prioritize the subwatersheds based on the lowest to highest score for each criterion, with the exception of the Neighborhood Source Area (NSA) restoration score. This approach to ranking was taken given the narrow range, or small numerical differences amongst the subwatersheds for many of the criteria. If there was no data available for a subwatershed, a 'no data' qualifier was added in the table and taken into consideration for the prioritization score and ranking. For instances where more than one subwatershed had the same value for a specific criterion, the same ordinal score was assigned. Ordinal scores were assigned in descending order.

4.2.1 Total Nitrogen and Total Phosphorus Loads

Annual total nitrogen and total phosphorus loads (lbs/year) were estimated for each subwatershed using land use-based loading rates defined by the Maryland Department of Environment (MDE) and the Chesapeake Bay Program (CBP). The pollutant loading analysis for the Area R watershed is explained in further detail in Appendix E, Chapter 3. A subwatershed loading rate (lb/acre/yr) for each nutrient was calculated from the total watershed load (lb/yr) and then divided by the subwatershed area. The subwatershed with the highest pollutant loading rate was assigned the lowest protection score (1) and the highest restoration score (6). Conversely, the subwatershed with the lowest pollutant loading rate was assigned the lowest restoration score (1) and the highest protection score (6). The results are shown in Table 4-1with total nitrogen loading rates ranging from 9.7 to 12.1 lb/acre/year and 0.25 to 0.47 lb/acres/year for total phosphorus.

Table 4-1: Total Nitrogen and Total Phosphorus Loading Rate Scores

Subwatershed	Total Nitrogen Loading Rate (lbs/acre/year)	Total Nitrogen Restoration Load Score	Total Nitrogen Protection Load Score	Total Phosphorus Loading Rate (lbs/acre/year)	Total Phosphorus Restoration Load Score	Total Phosphorus Protection Load Score
Dulaney Valley Branch	11.5	4	4	0.42	4	4
Fitzhugh Run	9.7	2	6	0.47	6	2
Jenkins Run	11.6	5	3	0.47	6	2
Greene Branch	11.1	3	5	0.40	3	5
Overshot Run	12.1	6	2	0.43	5	3
Royston Run	9.7	2	6	0.25	2	6

4.2.2 Biological Indicators

The Fish Index of Biotic Integrity (FIBI) and a benthic Index of Biotic Integrity (IBI) were used to rank the subwatersheds for priority restoration and protection. The scores for each of these indicators were determined on sampling data collected from Baltimore County Department of Environmental Protection and Sustainability (EPS) and Maryland Department of Natural Resources (MD DNR) Fisheries Service. Chapter 3 in Appendix E provides a detailed discussion of the data. See Appendix L for the full report titled *Biological Assessment for Loch Raven East Watershed (Area R).*

For each subwatershed, average FIBI and IBI scores were calculated using the data provided by EPS and MD DNR Fisheries Service. FIBI and IBI scores range from good (4.0 – 5.0) denoting minimally impacted conditions to very poor (1.0 – 1.9) indicating severe degradation. For restoration prioritization, lower biological indicator scores are assigned higher restoration scores to denote greater restoration need. In contrast, lower scores were given to a subwatershed with a high biological indicator score. For protection prioritization, higher scores are provided for subwatersheds with a high biological indicator score and lower scores are provided for subwatersheds with a low biological indicator score. The results are shown in Table 4-2.

Table 4-2: Fish and Benthic Indices Restoration and Protection Scores

Subwatershed	FIBI Average Score	FIBI Restoration Score	FIBI Protection Score	IBI Average Score	IBI Restoration Score	IBI Protection Score
Dulaney Valley Branch	2.17	6	3	3.73	6	3
Fitzhugh Run	2.33	5	4	3.83	5	4
Jenkins Run	n/d			n/d		
Greene Branch	2.50	4	5	4.00	4	5
Overshot Run	3.33	3	6	4.47	3	6
Royston Run	2.33	5	4	n/d		

4.2.3 Impervious Surfaces

The level of impervious cover of 4.8% in the Area R subwatershed suggests the watershed may be characterized as a 'sensitive' watershed. Sensitive watersheds have typically high quality streams with stable channels, good habitat conditions and good water quality according to the Impervious Cover Model described by Schueler et al (2009). The estimate of impervious cover for each subwatershed was based on data provided by Baltimore County that identifies roads, buildings and parking lots. Overall, all of the subwatersheds have very low impervious cover ranging from 3.1 to 6.1% (Table 4-3). However, research has found that Native Brook Trout and Brown Trout populations decline at two percent and four percent impervious cover, respectively (MD DNR 1999).

Table 4-3: Percent Impervious Surface Restoration and Protection Scores

Subwatershed	Total Area (acres)	Roads (acres)	Buildings (acres)	Total Impervious Area (acres)	% Impervious	% Impervious Restoration Score	% Impervious Protection Score
Dulaney Valley Branch	3,577.2	109.5	55.5	165.1	4.6	4	4
Fitzhugh Run	1,772.3	42.6	12.6	55.2	3.1	2	6
Jenkins Run	403.9	10.2	3.0	13.2	3.3	3	5
Greene Branch	3,472.4	135.3	53.0	188.2	5.4	5	3

Overshot Run	1,782.9	71.4	37.9	109.3	6.1	6	2
Royston Run	558.6	19.6	10.4	30.0	5.4	5	3

4.2.4 Neighborhood Restoration Opportunity/Pollution Severity Indices

A total of 30 neighborhoods were ranked and identified with the subwatershed in which the majority of its area was located. Although two neighborhoods were located in both Royston Run and Greene Branch, these neighborhoods were associated with Green Branch for the subwatershed prioritization process and subsequent management strategies. As a result, there are no neighborhoods ranked for Royston Run. Chapter 4 in Appendix E rated each neighborhood with a Pollution Severity Index (PSI) of high, moderate or none and a Restoration Opportunity Index (ROI) of high, moderate or low.

Restoration prioritization was rated with the highest score (4 points) given to subwatersheds with one or more neighborhoods with both a high PSI and ROI and one or more neighborhoods with a high PSI and moderate ROI score. The second highest score (3 points) was given to subwatersheds with one or more neighborhoods with a high PSI and a moderate ROI. The third highest score (2 points) was given to subwatersheds with four or more neighborhoods with both a moderate PSI and a moderate ROI. The remaining subwatersheds were assigned the lowest possible score (1 point). The results of the NSA restoration ranking scores are shown in Table 4-4.

Table 4-4: NSA PSI/ROI Restoration Scores

Subwatershed	Number of Neighborhoods for PSI/ROI Ratings							NSA PSI/ROI Restoration Score
	High/ High	High/ Moderate	High/ Low	Moderate/ High	Moderate/ Moderate	Moderate/ Low	Low/ Low	
Dulaney Valley Branch	0	0	0	0	9	2	1	2
Fitzhugh Run	0	0	0	0	2	0	0	1
Jenkins Run	0	0	0	0	0	1	0	1
Greene Branch	0	0	0	1	7	3	0	2
Overshot Run	0	1	0	0	2	1	0	3
Royston Run	0	0	0	0	0	0	0	0

4.2.5 Neighborhood Lawn Fertilizer Reduction/Awareness

Residential lawns were assessed as part of the SWAP using visual survey methods described in Chapter 4 in Appendix E. A lawn was designated as high maintenance if it had dense, uniform grass cover or signs designating pesticide/fertilizer lawn care applications. These high maintenance lawns were indicators of nutrient pollution originating from lawn fertilizer. Neighborhoods where 20 percent or more of the homes appeared to employ high lawn maintenance practices were recommended for fertilizer reduction/education during the NSAs. This criterion was issued for subwatershed restoration prioritization because a reduction in nutrient loading may be achieved through urban nutrient management practices as credited by the Chesapeake Bay Program and the TMDL. In addition, this criterion is the major restoration practice that was identified during the neighborhood assessments. Protection prioritization was not rated for this criterion because neighborhood lawn fertilizer reduction/awareness activities do not provide protection potential.

The ranking for this criterion is based on the acres of high maintenance lawns within the subwatershed. The acreage of lawns is expressed as a percentage of the total subwatershed area in Table 4-5. Subwatersheds with the greatest percentage of high maintenance lawns received the greatest restoration potential score (e.g. 6). Overall, the percentages of subwatershed area addressed through lawn fertilizer reduction were all below 10 percent.

Table 4-5: Neighborhood Lawn Fertilizer Reduction/Awareness Restoration Scores

Subwatershed	% of Subwatershed Addressed	NSA Lawn Fertilizer Reduction Restoration Score
Dulaney Valley Branch	5%	5
Fitzhugh Run	1%	4
Jenkins Run	0%	3
Greene Branch	7%	6
Overshot Run	0%	3
Royston Run	7%	6

4.2.6 Institutional Site Investigation

A total of 10 institutional sites were assessed in Area R; four churches, three golf courses, two elementary schools, and one park. Typically, institutional properties offer restoration opportunities to engage citizens in watershed stewardship and have large parcels of undeveloped land that may be considered for stormwater retrofits or tree planting, for example. The ranking of institutional sites was based on the total land area of these sites within a subwatershed. A higher restoration score was assigned with the more institutional land within a subwatershed. The highest score was given to Jenkins Run as this subwatershed has 190.5 acres of institutional land area, whereas Royston Run had zero acres of institutional land and received the lowest score of one. Protection prioritization was not rated for this criterion because the institutional site investigation doesn't provide protection potential. The results are summarized in Table 4-6.

Table 4-6: Institutional Site Restoration Scores

Subwatershed	ISI Acres	ISI Restoration Score
Dulaney Valley Branch	31.1	2
Fitzhugh Run	147.9	4
Jenkins Run	190.5	6
Greene Branch	183.2	5
Overshot Run	79.2	3
Royston Run	0.0	1

4.2.7 Stream Buffer Improvements

A stream buffer is defined as the 100 feet adjacent to either side of a stream channel. The condition of the stream buffer was classified into three categories based on its type of vegetative cover to include: forests, impervious and open pervious. Using Geographic Information Systems (GIS), impervious areas were determined by calculating the area of roads and buildings within the 100-foot stream buffer. The area of forest land cover within the stream buffer was determined using the forested GIS layer and removing any impervious area footprint. The remaining areas within the 100-foot stream buffer were classified as open pervious area. Open pervious areas (e.g., mowed lawns) represent the greatest potential for stream buffer reforestation. Therefore, the percentages of open pervious buffer area were used to prioritize restoration potential among subwatersheds. Subwatersheds with greater percentages of open pervious buffer areas denote the greatest potential for stream buffer improvement and were scored the highest for restoration prioritization. Subwatersheds with lower percentages of open pervious buffer areas have a higher percentage of forested buffer that are key areas for protection and are scored highest for protection prioritization. Jenkins Run received the highest buffer restoration score, whereas Royston Run had the highest protection score. The remaining four subwatersheds had similar percentages of open pervious land cover within the buffer, but the absolute area available for reforestation ranged from 85.6 to 259.2 acres as shown in Table 4-7.

Table 4-7: Stream Buffer Improvement Score

Subwatershed	Forested		Impervious		Open Pervious		Stream Buffer Improvement Restoration Score	Stream Buffer Improvement Protection Score
	Acres	%	Acres	%	Acres	%		
Dulaney Valley Branch	449.3	65.1	9.9	1.4	230.9	33.5	4	3
Fitzhugh Run	225.1	60.5	8.5	2.3	138.4	37.2	5	2
Jenkins Run	27.8	38.4	1.5	2.1	43.1	59.5	6	1
Greene Branch	529.5	65.9	14.6	1.8	259.2	32.3	3	4
Overshot Run	200.3	68.4	7.0	2.4	85.6	29.2	2	5
Royston Run	115.5	88.8	1.8	1.4	12.7	9.8	1	6

4.2.8 Septic Systems

According to Baltimore County Bay Restoration Fund tracking, there are approximately 2,500 septic systems in the Area R watershed. Nutrient and pathogens can be a source of pollutants if septic systems are not functioning properly. Subwatersheds with a greater number of septic systems have the greatest potential to be a nutrient and pathogenic pollutant source and were assigned a high restoration score. The number of septic systems in each subwatershed and septic system restoration score are provided in Table 4-8.

Table 4-8: Septic System Restoration Scores

Subwatershed	Number of Septic Systems	Septic System Restoration Score
Dulaney Valley Branch	826	6
Fitzhugh Run	147	3
Jenkins Run	32	1
Greene Branch	799	5
Overshot Run	551	4
Royston Run	145	2

4.2.9 Agricultural Land

Agricultural land uses including cropland, orchards, and pasture occupy 17.5% of the land area in Area R. The ranking criterion for agricultural land is based on the amount of land in conservation easements. Conservation easements relevant to Area R agricultural land include properties under the following programs: Rural Legacy, Maryland Environmental Trust/Local Land Trusts, Maryland Agricultural Land Preservation Foundation and Baltimore County Agricultural Land Preservation. Conservation easements protect significant natural resources on a property from development. A property owner maintains ownership of the land and may receive income, or estate and property tax benefits for the land area in a conservation easement. The acres of agricultural land without an easement and the protection score for each subwatershed is provided in Table 4-9. Royston Run was not included in this ranking criterion given the absence of agricultural land in this subwatershed.

Table 4-9: Agricultural Land Protection Scores

Subwatershed	Acres of Agriculture	Percent of Agriculture in easement	Percent of Agriculture not in easement	Agricultural Land Protection Score
Dulaney Valley Branch	579.5	4.1	95.9	6
Fitzhugh Run	521.1	43.1	56.9	2
Jenkins Run	95.7	24.6	75.4	5
Greene Branch	552.1	41.9	58.1	4
Overshot Run	279.9	42.5	57.5	3
Royston Run	0.0	0.0	n/a	n/a

4.2.10 Subwatershed Restoration and Protection Prioritization Summary

The six subwatersheds within Area R are ranked according to the total restoration and protection prioritization score (i.e., the sum of prioritization criterion scores). Subwatershed ranking results for restoration and protection are summarized in Table 4-10 and

Table 4-11 respectively including criterion scores, total scores and rankings. Table 4-12 provides a summary of the restoration and protection prioritization for each subwatershed.

Restoration Prioritization

The six subwatersheds within Area R are ranked according to the total restoration prioritization scores. Both fish and biological IBI scores were the same for each subwatershed. Only one of these scores was accounted for in the total score to avoid the biological indicators having a higher influence and biasing the ranking results. The total scores were adjusted to account for criteria not ranked for the subwatershed due to data availability. For example, if all of the nine criteria for restoration were ranked for a subwatershed, the total possible score was 52 points. In Jenkins Run, there were no data available to rank the biological indicators and consequently, the total possible score for this subwatershed was 46. Resultantly, the ranking is based on the total possible score for each watershed. The two highest scores were assigned a high rank, the two lowest scores a low rank, and the remaining two scores a moderate rank. Table 4-10 provides the scores for each criteria, total scores and ranking for restoration and protection, respectively. Dulaney Valley Branch and Greene Branch scored the highest for restoration and are the best targets for restoration. Jenkins Run and Overshot Run both were ranked as moderate priority subwatersheds. Fitzhugh Run and Royston Run scored the lowest for restoration overall.

Table 4-10: Subwatershed Restoration Ranking Results

Subwatershed	Total Nitrogen Load	Total Phosphorus Load	Fish IBI	Biological IBI	Impervious Surfaces	NSA PSI/ROI	NSA Lawn Fertilizer Reduction	ISI Site Investigation	Stream Buffer Improvement	Septic Systems	TOTAL SCORE	NORMALIZED SCORE	SUBWATERSHED RANK
Dulaney Valley Branch	4	4	6	6	4	2	5	2	4	6	37	71	High
Fitzhugh Run	2	6	5	5	2	1	4	4	5	3	32	62	Low
Jenkins Run	5	6	n/d	n/d	3	1	3	6	6	1	31	67	Moderate
Greene Branch	3	3	4	4	5	2	6	5	3	5	36	69	High
Overshot Run	6	5	3	3	6	3	3	3	2	4	35	67	Moderate
Royston Run	2	2	5	n/d	5	0	6	1	1	2	24	46	Low

Protection Prioritization

Subwatersheds were placed into one of three protection priority categories, high, moderate and low, based on ranking results. Both fish and biological IBI scores were the same for each subwatershed. Only one of these scores was accounted for in the total score to avoid the biological indicators having a higher influence and biasing the ranking results. The total scores were adjusted to account for criteria not ranked for the subwatershed due to data availability. For example, if all of the six criteria for restoration were ranked for a subwatershed, the total possible score was 36 points. In Jenkins and Royston Run, there were no data available to rank either both of the biological indicators or the agricultural land in easement, and the total possible score for these two subwatersheds was 30 points. Resultantly, the ranking is based on the total possible score for each watershed. The two highest scores were assigned a high rank, the two lowest scores a low rank, and the remaining two scores a moderate rank. These results are summarized in Table 4-11and Table 4-12and illustrated in Figure 4-1. Royston Run and Greene Branch subwatersheds scored the highest and are the best targets for protecting water quality in the watershed. Dulaney Valley Branch and Fitzhugh Run were both ranked as moderate priority subwatersheds. Jenkins and Overshot Run scored the lowest for protection overall.

Table 4-11: Subwatershed Protection Ranking Results

Subwatershed	Total Nitrogen Load	Total Phosphorus Load	Fish IBI	Biological IBI	Impervious Surfaces	Stream Buffer Improvement	Agricultural Land	TOTAL SCORE	NORMALIZED SCORE	SUBWATERSHED RANK
Dulaney Valley Branch	4	4	3	3	4	3	6	24	67	Moderate
Fitzhugh Run	6	2	4	4	6	2	2	22	61	Moderate
Jenkins Run	3	2	n/d	n/d	5	1	5	16	53	Low
Greene Branch	5	5	5	5	3	4	4	26	72	High
Overshot Run	2	3	6	6	2	5	3	21	58	Low
Royston Run	6	6	4	n/d	3	6	n/d	25	83	High

Table 4-12: Subwatershed Restoration and Protection Prioritization

Subwatershed	Total Normalized Restoration Score	Restoration Prioritization Category	Total Normalized Protection Score	Protection Prioritization Category
Dulaney Valley Branch	71	High	67	Moderate
Fitzhugh Run	62	Low	61	Moderate
Jenkins Run	67	Moderate	53	Low
Greene Branch	69	High	72	High
Overshot Run	67	Moderate	58	Low
Royston Run	46	Low	83	High

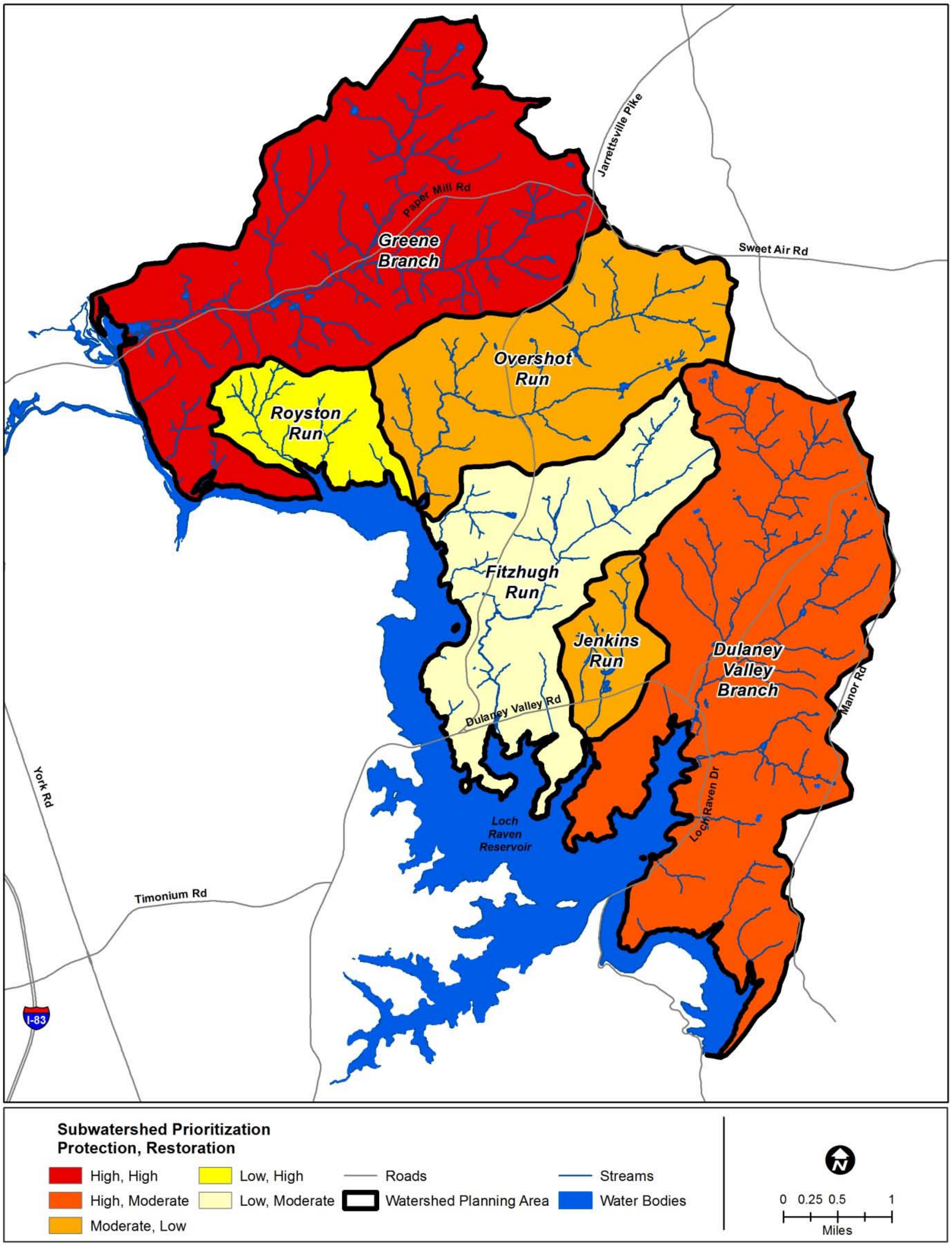

Figure 4-1: Subwatershed Protection and Restoration Priority Ranking

4.3 Subwatershed Restoration and Protection Strategies

Restoration and protection management strategies for each subwatershed are presented in the following subsections. The strategies are based on strategies presented in Chapter 3 and site specific actions (i.e., see Chapters 3 and 4 in Appendix E). Appendix A presents measurable actions that correspond to each strategy and the goals and objectives described in Chapter 2. This section includes the results of the stream assessment and upland assessments (Appendix E) and available agricultural data. For each subwatershed, key characteristics are presented that include drainage area, stream length, total population, land use/land cover, land in easement, impervious cover, hydrologic soil group, stormwater management (SWM) facilities and restoration and protection priority ranking. A summary of assessment results for neighborhoods, hotspots, institutions, stream corridors and stormwater conversions are provided for each subwatershed. Finally, a subwatershed management strategy including recommended citizen and municipal actions are presented at the end of each section.

4.3.1 Dulaney Valley Branch

Dulaney Valley Branch is the largest subwatershed within the Area R drainage area, having an area of just over five and a half square miles (5.6 mi^2). The existing land use consists primarily of low/very low density residential, agriculture, and forest land uses. The majority of the development occurred in the past fifty years, from the 1950s through 2010. Almost half (46.8%) of the land areas is low/very low density residential and twelve percent is agriculture. Over 450 acres, or thirteen percent, are within conservation easements with 23.8 acres of agricultural land in conservation easement in the watershed. Table 4-13 summarizes the key subwatershed characteristics of Dulaney Valley Branch.

Table 4-13 : Dulaney Valley Branch Subwatershed Key Characteristics

Drainage Area	3,577.2 acres (5.6 mi^2)	
Stream Length	23.9 miles	
Total Population	2,026 (2010 Census) 0.6 people/acre	
Land Use/Land Cover	Very Low Density Residential (Agriculture):	5.2%
	Very Low Density Residential (Forested):	5.0%
	Low Density Residential:	36.6%
	Medium Density Residential:	0.0%
	Commercial:	0.0%

	Institutional:	0.2%
	Open Urban Land:	0.1%
	Agriculture (Cropland, Orchards, Pasture):	16.2%
	Forest:	34.7%
	Water and Wetlands:	2.1%
Land in Easement	469.5 acres (13.2%)	
Impervious Cover	4.6% of Subwatershed	
Hydrologic Soil Group	A soils (low runoff potential): B soils: C soils: D soils (high runoff potential):	0.0% 80.4% 18.8% 0.8%
SWM Facilities	7 Facilities 0.1% of urban land use treated	
Restoration/Protection Priority Rating	High/Moderate	

Neighborhood Source Assessment

A total of 12 distinct neighborhoods were identified and assessed within the Dulaney Valley Branch subwatershed during the uplands assessment of Area R. Characteristics such as lot size, age, and type of development were used to delineate neighborhoods rather than subwatershed boundaries. Recommendations for addressing stormwater volume and pollutants within this subwatershed include fertilizer reduction, rain gardens, Bayscape and storm drain marking. In addition to the actions identified in Table 4-14, there is potential for stormwater retrofits in NSA_R_4 (bioretention practice in the cul-de-sac) and NSA_R_5 (conversion of grass ditch to swale).

The results of the Neighborhood Source Assessment (NSA) are presented in Table 4-14.

Table 4-14: Actions identified for neighborhoods in Dulaney Valley Branch

Site ID	Lot Size (acres)	Rain Garden/Rain Barrels/Downspout Disconnection	Storm Drain Marking	Bayscape	Fertilizer Reduction	Lot Canopy
NSA_R_1	>1	X	X			

Site ID	Lot Size (acres)	Rain Garden/Rain Barrels/Downspout Disconnection	Storm Drain Marking	Bayscape	Fertilizer Reduction	Lot Canopy
NSA_R_2	1/2	X	X			X
NSA_R_3	>1		X	X		
NSA_R_4	>1		X	X	X	
NSA_R_5	>1		X			
NSA_R_7	>1	X	X			
NSA_R_9	>1	X	X		X	X
NSA_R_10	>1	X	X	X	X	X
NSA_R_11	>1	X	X	X		X
NSA_R_13	>1	X		X	X	X
NSA_R_22	>1	X	X	X	X	X
NSA_R_28	>1	X	X	X		

Twelve of the thirteen neighborhoods are identified for storm drain marking. Nine neighborhoods were identified for rain gardens, eight were identified for Bayscape, and six were identified for fertilizer reduction. In addition, three of the neighborhoods were identified for stream buffer improvement. Figure 4-2 provides an example residential yard that may be suitable for a rain garden and another yard with stream buffer encroachment.

Figure 4-2: Left: Expansive turfgrass lawn in NSA_R_11 that slopes downgradient from the house and provides an opportunity for a rain garden. Right: Stream buffer encroachment in NSA_R_4.

Hotspot Site Investigation

One commercial hotspot site was assessed and identified as 'not a hotspot.'

Institutional Site Investigation

One elementary school and one faith-based institutional site were assessed in the Dulaney Valley Branch subwatershed (ISI_R_601 and ISI_R_602). A total of 200 trees are recommended for planting at the elementary school and storm drain marking was recommended for the church. Downspout disconnection was identified for both sites. Specifically, the downspouts at the church are recommended for rain barrels because they discharge to a confined space with landscaping in an area between the buildings. The downspouts at the school are most likely connected to the storm drain system and are recommended for simple disconnection. The actions identified for the ISI are shown in Table 4-15.

Table 4-15: Identified Actions for the Institutional Sites in Dulaney Valley Branch

Site ID	Type	Identified Actions					
		Tree Planting	Stormwater Retrofit	Downspout Disconnect-ion	Trash Mgmt.	Storm Drain Marking	Stream Buffer Improv.
ISI_R_601	Elementary School	200	N	Y	N	N	N
ISI_R_602	Faith-Based	0	N	Y	N	Y	N

Pervious Area Assessment

Along the watershed divide between Dulaney Valley Branch and Jenkins Run, there are three parcels owned by Baltimore County (PAA_R_601). These open fields are located on either side of Peerce's Plantation. There is potential to reforest 90 acres on this site. No streams are present on the site, but the PAA is less than 900 feet from the reservoir. Dulaney Valley Road divides the site from a forest patch containing interior forest area. A 4-5 acre utility right-of-way bisects the PAA.

St. John's Evangelical Church on Manor Road (PAA_R_602) is the smallest of the PAA sites in the Dulaney Valley Branch subwatershed that has approximately two acres of turf that could be planted with trees. Since it does not have a stream on the site and it is not close to forest interior, it scored low for priority. There is potential for a stormwater retrofit next to the parking lot.

Stream Corridor Assessment

During the 2012 stream corridor assessment (SCA), approximately 14.0 miles of stream were assessed (58% of total stream miles). The most severe problems observed were erosion sites, pipe outfalls, inadequate stream buffers, and fish barriers. The stabilization of streambanks and other restoration measures can provide numerous benefits, including nutrient and sediment load reductions and improved habitat health for aquatic biota. An additional 1.3 stream miles were previously assessed during a 1997 study, for a total combined 15.3 miles of streams assessed within the subwatershed. Although, the potential stream restoration sites identified from the SCA surveys calls attention to particular erosion and channel stability issues observed in 2012, the entire stream assessment data set should be considered when watershed management implementation activities are being prioritized for the Dulaney Valley Branch subwatershed. Individual findings are discussed in Appendix E (Section 3.5) and complete SCA data tables are available in Appendix F.

These restoration areas represent streams where erosion and unstable channel conditions are concentrated based on the assessments conducted during the SCA surveys. A majority of these areas are located in headwater, or first order, tributaries. Approximately 36 percent of the total channel erosion length surveyed in 2012 is concentrated in eight stream areas, referred to as ‘areas’ A to H, within Dulaney Valley Branch subwatershed. The restoration areas are ranked according to the square feet of erosion calculated from the length of erosion times the average bank height of the channel at the problem location.

Table 4-16 shows the ranking of potential stream restoration areas identified in the Dulaney Valley Branch subwatershed. Figure 4-3 illustrates the severe and very severe erosion sites found in Dulaney Valley Branch during the SCA.

Table 4-16: Ranking of Potential Stream Restoration Areas.

Stream Restoration Area Ranking	Potential Stream Restoration Area ID	Erosion Length (ft)	Erosion Area (sf)
1	E	1,402	5,832
2	B	1,089	4,673
3	A	1,614	3,587
4	C	421	3,368
5	D	496	1,937
6	G	158	1,059
7	H	163	978
8	F	38	190

Stream restoration areas E, B, and A rank the highest when factoring the square feet of potential erosion calculated for the eight areas. Area E represents three stream reaches that are grouped together based on observations made on construction access through existing utility right-of-ways, trails, and/or old roads during the field surveys. The northern reach of Area E is

Figure 4-3: Severe and very severe problems identified in Dulaney Valley Branch; unusual condition – concrete slab in channel (top left), erosion (top right), fish migration blockage (bottom left), and exposed pipe (bottom right).

also associated with case study area 7 from the 1997 Loch Raven report. This case study area represented 1,600 linear feet of potential stream restoration and the highest ranked reaches for stream restoration in the study area. Potential stream restoration areas A and B represent two separate stream systems but could be implemented as one project. Area F ranked the lowest when factoring square feet of potential erosion out of the eight areas. However, this site also represents an opportunity to protect an existing pipe exposed on the right bank, improve floodplain access, and possibly restore floodplain wetlands. These potential stream restoration areas should also consider the other problems identified and documented during the SCA surveys, especially pipe outfalls, fish migration barriers, and opportunities to enhance riparian buffers.

Subwatershed Management Strategy

Restoration and protection strategies are outlined below.

<u>Engaging Citizens & Watershed Groups</u>

1. Encourage citizens to adopt landscape practices to increase native plants to include woody vegetation and removal of invasive vegetation.
2. Increase homeowner awareness with proper buffer management in regulated areas (easements) to maintain existing and reforest impacted stream buffers with native plants, to include woody vegetation and removal of invasive vegetation.
3. Encourage citizens to adopt landscape practices to increase native vegetation and habitat and decrease turfgrass to include Bayscapes.
4. Inform citizens on the importance of septic system maintenance.
5. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods.
6. Engage property owners in downspout disconnection onto adjacent pervious surfaces or into retrofitted rain barrels or rain gardens.

<u>Municipal Actions</u>

7. Identify opportunities to partner with local organizations and the garden club to assist with outreach efforts and to focus on organizations with an existing rain barrel or rain garden program/initiative.
8. Evaluate stream restoration projects to stabilize stream channels for priority sites.
9. Investigate additional SWM BMP opportunities within headwater or first order tributaries currently without appropriate SWM control. For example, opportunities for stormwater retrofits in NSA_R_4 (bioretention practice in the cul-de-sac) and NSA_R_5 (conversion of grass ditch to swale).
10. Conduct a retrofit assessment at St. John's Evangelical Church (ISI_R_602) and work with property owners to identify options for implementation of the recommended actions to include downspout disconnection, storm drain marking and tree planting.
11. Plant trees and implement downspout disconnection at the elementary school (ISI_R_601).
12. Work with local and state non-profit organizations and departments to increase the land in conservation easements from the existing 13%.
13. Investigate the effectiveness of existing deer management programs and potential additional deer management options.
14. Provide access to deer management information to homeowners.

4.3.2 Fitzhugh Run

Fitzhugh Run is one of the mid-sized subwatersheds within the Area R drainage area, having an area of just under three square miles (2.8 mi^2). The existing land use consists primarily of low/ very low density residential, agriculture, and forest land uses. Development peaked in the

1960s and 1970s, with smaller amounts of development built prior to and after this time period. Twenty percent of the land areas is low, very low density residential and almost thirty percent (29.4%) is agriculture. Over 300 acres, or eighteen percent, are within conservation easements with 224.5 acres of agricultural land in conservation easement in the watershed. Table 4-17 summarizes the key subwatershed characteristics of Fitzhugh Run.

Table 4-17: Fitzhugh Run Subwatershed Key Characteristics

Drainage Area	1,772.3 acres (2.8 mi^2)	
Stream Length	12.2 miles	
Total Population	420.5 (2010 Census) 0.2 people/acre	
Land Use/Land Cover	Very Low Density Residential (Agriculture):	6.1%
	Very Low Density Residential (Forested):	2.2%
	Low Density Residential:	11.7%
	Medium Density Residential:	0.0%
	Commercial:	0.0%
	Institutional:	0.0%
	Open Urban Land:	1.6%
	Agriculture (Cropland, Orchard, Pasture):	29.4%
	Forest:	47.4%
	Water and Wetlands:	1.6%
Land in Easement	319.1 acres (18.0%)	
Impervious Cover	3.1% per Subwatershed	
Hydrologic Soil Group	A soils (low runoff potential): B soils: C soils: D soils (high runoff potential):	0.0% 83.2% 14.7% 2.1%
SWM Facilities	3 Facilities 3.1% of urban land use treated	
Restoration/Protection Priority Rating	Low/Moderate	

Neighborhood Source Assessment

A total of 2 distinct neighborhoods were identified and assessed within the Fitzhugh Run subwatershed during the uplands assessment of Area R. Characteristics such as lot size, age, and type of development were used to delineate neighborhoods rather than subwatershed boundaries. Recommendations for addressing stormwater volume and pollutants within this subwatershed include fertilizer reduction, rain gardens, Bayscape and storm drain marking. Stormwater retrofit opportunities are also present in NSA_R_27A to include a bioretention in a cul-de-sac.

The results of the Neighborhood Source Assessment (NSA) are presented in Table 4-18.

Table 4-18: Actions identified for neighborhoods in Fitzhugh Run.

Site ID	Lot Size (acres)	Rain Garden	Storm Drain Marking	Bayscape	Fertilizer Reduction	Lot Canopy
NSA_R_12	>1	X	X	X	X	
NSA_R_27A	>1	X	X	X		

The assessment identified neighborhoods for storm rain gardens, drain marking and Bayscaping. Figure 4-4illustrates typical yards identified for fertilizer management.

Figure 4-4: Expansive turfgrass lawns in neighborhoods of Fitzhugh Run (NSA_R_12 and NSA_R_27A).

Hotspot Site Investigation

No hotspots were identified for this subwatershed.

Institutional Site Investigation

One golf course was assessed in the Fitzhugh Run subwatersheds (ISI_R_401). Redirection of stormwater discharge a stormwater treatment practice is recommended for the cart storage area. The actions identified for the ISI are shown in Table 4-19.

Table 4-19: Identified Actions for the Institutional Site in Fitzhugh Run

		Identified Actions					
Site ID	Type	Tree Planting	Stormwater Retrofit	Downspout Disconnect-ion	Trash Mgmt.	Storm Drain Marking	Stream Buffer Improv.
ISI_R_401	Golf Course	0	Y	N	N	N	N

Pervious Area Assessment

The Maryland Department of Natural Resources, Gunpowder State Park (PAA_R_401), contains six parcels in close proximity that were combined into a single PAA along Jarrettsville Pike. The pervious area totals 176 acres. Numerous stream reaches are present on these properties, providing a great opportunity for stream buffer planting. The PAA borders city-owned reservoir watershed land, and is very close to the Loch Raven Reservoir. Portions of the PAA are connected to forested areas with forest interior. There are a few places that meet the definition of exterior forest gap. This PAA is high priority for reforestation because of its size, presence of unforested streams and exterior forest gaps, and proximity to forest interior. It received the maximum score for priority. The State currently has agricultural leases on these fields.

Stream Corridor Assessment

The 1997 Water Quality Management Plan for Loch Raven Watershed (Tetra Tech, 1997) identified one potential stream restoration site in the Fitzhugh Run subwatershed. The site is associated with case study area 8 and is located just southeast of the intersection of Jarrettsville Pike and Blenheim Road. Refer to Figure S8-1 in the 1997 Loch Raven report for more detailed locations of the reaches associated with case study area 8. This case study area represented 2,140 linear feet of potential stream restoration and ranked the third highest for stream restoration in the study area. As indicated above, the stream assessments initially focused on second and third order streams. However, during the field assessments it was observed that many of the first order streams within the case study areas should be considered in the overall development of watershed implementation activities.

Subwatershed Management Strategy

Restoration and protection strategies are outlined below.

Engaging Citizens & Watershed Groups

1. Promote awareness of the benefits of proper lawn care in the neighborhood NSA_R_12.
2. Increase homeowner awareness with buffer management in regulated areas (easements) to increase native plants to include woody vegetation and removal of invasive vegetation.
3. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-18.
4. Inform citizens on the importance of septic system maintenance.
5. Engage property owners in downspout disconnection onto adjacent pervious surfaces or into retrofitted rain barrels or rain gardens.

Municipal Actions

6. Identify opportunities to partner with local organizations and the garden club to assist with outreach efforts for homeowner stewardship practices.
7. Conduct a retrofit assessment at the golf course for the cart storage area for potential stormwater practices and implement recommended action.
8. Conduct a retrofit assessment in NSA_R_27A for a bioretention and a potential regenerative stormwater conveyance practice in ISI_R_401.
9. Work with local and state non-profit organizations and departments to increase the land in conservation easements.
10. Investigate stream restoration potential at the site in Fitzhugh Run, located southeast of the intersection of Jarrettsville Pike and Blenheim Road.
11. Support City of Baltimore efforts to protect and restore forested buffers on reservoir lands.
12. Work with Gunpowder Valley Conservancy to create or enhance riparian stream buffers.
13. Work with State DNR to identify opportunity to expand stream buffers within Gunpowder State Park.
14. Investigate the effectiveness of existing deer management programs and potential additional deer management options.
15. Provide access to deer management information to homeowners.

4.3.3 Jenkins Run

Jenkins Run is the smallest subwatershed within the Area R drainage area having an area of just over a half of a square mile (0.6 mi^2). The existing land use consists primarily of open urban, agriculture, very low density residential, and forest land uses. The majority of the development occurred in 1970s, with smaller amounts of development in the 1980s. Twenty four percent of the land area is agriculture and 11.5 percent is low density residential. Almost 40 acres, or 9.5 percent, are within conservation easements with 23.5 acres of agricultural land in conservation easement in the watershed.

Table 4-20 summarizes the key subwatershed characteristics of Jenkins Run.

Table 4-20: Jenkins Run Subwatershed Key Characteristics

Drainage Area	403.9 acres (0.6 mi^2)	
Stream Length	3.2 miles	
Total Population	66.8 (Census 2010) 0.2 people/acre	
Land Use/Land Cover	Very Low Density Residential (Agriculture):	0.0%
	Very Low Density Residential (Forested):	0.0%
	Low Density Residential:	11.5%
	Medium Density Residential	0.0%
	Commercial:	0.0%
	Institutional	0.0%
	Open Urban Land:	31.0%
	Agriculture (Cropland, Orchard, Pasture):	23.7%
	Forest:	31.8%
	Water and Wetlands:	0.0%
Land in Easement	38.5 acres (9.5%)	
Impervious Cover	3.3% per Subwatershed	
Hydrologic Soil Group	A soils (low runoff potential): B soils: C soils: D soils (high runoff potential):	0.0% 85.1% 12.8% 2.1%
SWM Facilities	1 Facility 2.3% urban land treated	
Restoration/Protection Priority Rating	Moderate/Low	

Neighborhood Source Assessment

One neighborhood was identified and assessed within the Jenkins Run subwatershed during the uplands assessment of Area R. Characteristics such as lot size, age, and type of development were used to delineate neighborhoods rather than subwatershed boundaries. Recommendations for addressing stormwater volume and pollutants within this subwatershed include fertilizer reduction, Bayscape and storm drain marking.

The results of the Neighborhood Source Assessment (NSA) are presented in Table 4-21.

Table 4-21: Actions identified for neighborhoods in Jenkins Run

Site ID	Lot Size (acres)	Rain Garden	Storm Drain Marking	Bayscape	Fertilizer Reduction	Lot Canopy
NSA_R_08	>1		X	X	X	

Eighty percent of the lawns in this one neighborhood in Jenkins Run were high maintenance and are recommended for fertilizer reduction and Bayscaping. Figure 4-5 illustrates a typical lawn.

Figure 4-5: High maintenance turfgrass lawn and opportunity for storm drain marking in NSA_R_08.

Hotspot Site Investigation

No hotspots were identified for this subwatershed.

Institutional Site Investigation

A golf course was the only institutional site assessed in the Jenkins Run subwatershed (ISI_R_501). This site was recommended for regenerative stormwater conveyance to repair a serious erosion problem. Stream buffer improvement is also recommended due to encroachment. The actions identified for the ISI are shown in Table 4-22

Table 4-22: Identified Actions for Institutional Sites in Jenkins Run

Site ID	Type	Identified Actions					
		Tree Planting	Stormwater Retrofit	Downspout Disconect-ion	Trash Mgmt.	Storm Drain Marking	Stream Buffer Improv.
ISI_R_501	Golf Course	0	Y	N	N	N	Y

Pervious Area Assessment

No pervious areas were assessed for this subwatershed.

Stream Corridor Assessment

A stream corridor assessment was not completed for this subwatershed.

Subwatershed Management Strategy

Restoration and protection strategies are outlined below.

Engaging Citizens & Watershed Groups

1. Promote awareness of the benefits of proper disposal of yard waste.
2. Inform citizens on the importance of septic system maintenance.
3. Encourage citizens to adopt landscape practices to increase native vegetation and habitat, and decrease turfgrass to include Bayscapes.
4. Increase homeowner awareness with proper buffer management in regulated areas (easements) to maintain existing and reforest impacted stream buffers with native plants, to include woody vegetation and removal of invasive vegetation.
5. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods indicated in Table 4-21.
6. Promote awareness of Stream Watch, an adopt-a-stream program to clean and monitor stream conditions.
7. Engage property owners in downspout disconnection onto adjacent pervious surfaces or into retrofitted rain barrels or rain gardens.

Municipal Actions

8. Identify opportunities to partner with local organizations and the garden club to assist with outreach efforts and to focus on organizations with an existing rain barrel or rain garden program/initiative.
9. Further evaluate stormwater retrofit (regenerative stormwater conveyance) and stream buffer improvement at the golf course (ISI_R_501).
10. Work with MD Department of Natural Resources to identify sites for Stream Waders Programs and/or MBSS program.
11. Identify sites for county biological monitoring program.
12. Support City of Baltimore efforts to protect and restore forested buffers on Reservoir Lands.
13. Investigate the effectiveness of existing deer management programs and potential additional deer management options.
14. Provide access to deer management information to homeowners.

4.3.4 Greene Branch

Greene Branch is one of the largest subwatersheds within the Area R drainage area having an area of just under five and half square miles ($5.4 mi^2$). The existing land use consists primarily of low/very low density residential and forest land uses. The majority of the development occurred in the past fifty years, from the 1950s through 2010. The next largest land use is forest at thirty percent of the subwatershed area. An estimated 231 acres, or 41.9% of the subwatershed agricultural land use, is within conservation easements. Table 4-23 summarizes the key subwatershed characteristics of Greene Branch.

Table 4-23: Greene Branch Subwatershed Key Characteristics

Drainage Area	3,472.4 acres ($5.4 mi^2$)	
Stream Length	32.8 miles	
Total Population	1,925.7 (Census 2010) 0.6 people/acre	
Land Use/Land Cover	Very Low Density Residential (Agriculture):	4.3%
	Very Low Density Residential (Forested):	8.3%

	Low Density Residential:	32.4%
	Medium Density Residential	0.3%
	Commercial:	1.7%
	Institutional:	0.0%
	Open Urban Land:	5.4%
	Agriculture (Cropland, Orchard):	15.9%
	Forest:	30.6%
	Water and Wetlands:	1.0%
Land in Easement	416.5 acres (12.0%)	
Impervious Cover	5.4% per Subwatershed	
Hydrologic Soil Group	A soils (low runoff potential): B soils: C soils: D soils (high runoff potential):	0.9% 81.1% 16.1% 1.8%
SWM Facilities	8 Facilities 1.5% of urban land use treated	
Restoration/Protection Priority Rating	High/High	

Neighborhood Source Assessment

A total of 11 distinct neighborhoods were identified and assessed within the Greene Branch subwatershed during the uplands assessment of Area R. Characteristics such as lot size, age, and type of development were used to delineate neighborhoods rather than subwatershed boundaries. Recommendations for addressing stormwater volume and pollutants within this subwatershed include fertilizer reduction, rain gardens, Bayscape and storm drain marking.

The results of the Neighborhood Source Assessment (NSA) are presented in Table 4-24.

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Table 4-24: Actions Identified for Neighborhoods in Greene Branch

Site ID	Lot Size (acres)	Rain garden	Storm Drain Marking	Bayscape	Fertilizer Reduction	Lot Canopy
NSA_R_14	½	X		X		X
NSA_R_15	>1	X	X	X	X	
NSA_R_17_20	>1	X	X	X	X	
NSA_R_18	>1	X	X	X	X	
NSA_R_19	1	X	X	X	X	
NSA_R_23A	>1	X	X	X	X	X
NSA_R_23B	>1			X	X	
NSA_R_24	>1	X	X	X		X
NSA_R_25A	>1	X		X	X	
NSA_R_25B		X		X	X	X
NSA_R_29			X	X	X	

Ten of the eleven neighborhoods are identified for fertilizer reduction. Despite the expansive turfgrass lawns shown in Figure 4-6, seven of the eleven neighborhoods had lot canopy cover estimated at forty percent or greater. This is attributed to the front lawns dominated with turfgrass, while the side and backyards have woody vegetation as shown in Figure 4-6. Only two of the neighborhoods with canopy cover less than 40 percent were recommended for better stream buffer management (NSA_R_24, NSA_R_25B). Two additional neighborhoods were identified for lot canopy improvement (NSA_R_14 and NSA_R_23A).

Figure 4-6: Expansive turfgrass lawns in neighborhoods of Greene Branch in the front-yards with forested-like conditions in the back- and side-yards (NSA_25A and NSA_29)

Hotspot Site Investigation

A total of five hotspot sites were assessed to include four commercial sites and one municipal site. A restaurant site with improper grease storage was confirmed during the assessment and was reported to Baltimore County (Figure 4-7, left). All other hotspots are identified as a ‘potential’ hotspot as the storage of materials, vehicle operations, condition of the building, waste management, landscaping or stormwater management may pollutant nearby streams. The most prominent pollution source at the HSI sites was condition of the dumpster lacking a lid or in poor condition along with the direct connection of downspouts to storm drains from the building. Stormwater was a likely pollutant source as there was not much evidence of stormwater management facilities at these sites with the exception of one site, HSI_R_101 (Figure 4-7, right).

Figure 4-7: Hotspot investigation sites with a confirmed hotspot (shown left) and a stormwater management practice at a commercial site (shown right)

Institutional Site Investigation

A faith-based site and a golf course are the two institutional sites assessed in the Greene Branch subwatersheds (ISI_R_101 and ISI_R_102). Both of these sites are recommended for stormwater retrofits, with additional recommendation for stream buffer improvement at the golf course. The retrofits included conversion to an extended detention pond at the golf course and the installation of a rain garden at the church to capture and treat roof runoff. The actions identified for the ISIs are shown in Table 4-25.

Table 4-25: Identified Actions for Institutional Sites in Greene Branch

Site ID	Type	Identified Actions					
		Tree Planting	Stormwater Retrofit	Downspout Disconnect-ion	Trash Mgmt.	Storm Drain Marking	Stream Buffer Improv.
ISI_R_101	Faith-Based	0	Y	N	N	N	N
ISI_R_102	Golf Course	0	Y	N	N	N	Y

Pervious Area Assessment

The Baltimore County, Department of Public Works – Public Safety and Training Academy (PAA_R_101) was identified as a site for future tree planting and a stormwater retrofit. The academy is surrounded by forest on three sides. The site is in use as a training facility, including training in the use of heavy equipment. This type of training requires a fair amount of space, however there appears to be approximately seven acres not in use. This area is either mowed grass or in meadow. The site may have special considerations and will require further investigation, as it was formerly used as a Nike missile silo. In addition to tree planting, the site has potential for a stormwater retrofit near the gate. There is a high priority for restoration at this site.

Stream Corridor Assessment

The 1997 Water Quality Management Plan for Loch Raven Watershed (Tetra Tech, 1997) included more than five miles of stream assessment in the Greene Branch subwatershed. Less than two percent of the assessed reaches ranked poor or very poor for channel instability. Seventeen of the twenty-one reaches were classified as F channels and one reach was classified as a G channel, representing entrenched and deeply entrenched stream channels.

Subwatershed Management Strategy

Restoration and protection strategies are outlined below.

<u>Engaging Citizens & Watershed Groups</u>

1. Promote awareness of the benefits of proper lawn care in the neighborhoods.
2. Encourage homeowners to maintain existing and reforest impacted stream buffers with native plants, to include woody vegetation and remove invasive vegetation.
3. Encourage citizens to adopt techniques to increase native vegetation and habitat, and decrease turfgrass to include Bayscapes.
4. Inform citizens on the importance of septic system maintenance.
5. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods.

6. Engage property owners in downspout disconnection onto adjacent pervious surfaces or into retrofitted rain barrels or rain gardens.
7. Promote awareness of Stream Watch, an adopt-a-stream program to clean and monitor stream conditions.

Municipal Actions

8. Revisit stream reaches assessed as F and G channels in the 1997 Loch Raven study to re-evaluate stream conditions and recommend restoration actions as needed.
9. Conduct a retrofit assessment at the Public Safety and Training Academy, golf course and church and implement recommended action.
10. Conduct education and outreach activities to commercial businesses on proper waste management and disposal.
11. Work with local and state non-profit organizations and departments to increase the land in conservation easements.
12. Identify opportunities to partner with local organizations such as the garden club and the Gunpowder Valley Conservancy to implement lot-level, invasive removal and tree planting projects.
13. Work with local organizations to promote the Stream Waders Program.
14. Continue County biological monitoring program.
15. Investigate the effectiveness of existing deer management programs and potential additional deer management options.
16. Provide access to deer management information to homeowners.

4.3.5 Overshot Run

Overshot Run is one of the smallest subwatersheds within the Area R drainage area, located adjacent to the Reservoir and having an area of just under one square miles (0.9 mi^2). The existing land use consists primarily of forest and low density residential land uses. Fifty-one percent of the land area is low or very low density residential development. Development peaked in the 1950s and 1960s, with smaller amounts of development built prior to and after this time period. Overshot Run has the second largest area in conservation easement within the Area R drainage area with 456 acres or nearly 26% of the land area in conservation easement. Table 4-26 summarizes the key subwatershed characteristics of Overshot Run.

Neighborhood Source Assessment

A total of eight neighborhoods were identified within the Overshot Run subwatershed during the uplands assessment of Area R, however only four neighborhoods were completely or had the majority of the land area with Overshot Run. A summary of actions suggested for these neighborhoods are identified as part of the restoration and protection strategies for Overshot Run.

The results of the Neighborhood Source Assessment (NSA) are presented in Table 4-27.

Table 4-26: Overshot Run Subwatershed Key Characteristics

Drainage Area	1,782.9 acres (2.8 mi^2)	
Stream Length	12.5 miles	
Total Population	1,192.6 (Census 2010) 0.7 people/acre	
Land Use/Land Cover	Very Low Density Residential (Agriculture):	3.8%
	Very Low Density Residential (Forested):	6.0%
	Low Density Residential:	34.1%
	Medium Density Residential:	3.4%
	Commercial:	0.7%
	Institutional	2.3%
	Open Urban Land:	6.8%
	Agriculture:	15.7%
	Forest:	27.1%
	Water and Wetlands:	0.1%
Land in Easement	456.3 acres (25.6%)	
Impervious Cover	6.1% per Subwatershed	
Hydrologic Soil Group	A soils (low runoff potential): B soils: C soils: D soils (high runoff potential):	0.8% 79.7% 14.5% 5%
SWM Facilities	8 Facilities 9.9% of urban land treated	
Restoration/Protection Priority Rating	Moderate/Low	

Table 4-27: Actions Identified for Neighborhoods in Fitzhugh Run

Site ID	Lot Size (acres)	Rain Garden	Storm Drain Marking	Bayscape	Fertilizer Reduction	Lot Canopy
NSA_R_06	½ acre		X	X		X
NSA_R_16	> 1 acre	X	X	X	X	
NSA_R_21	½ acre					X
NSA_R_26	> 1 acre	X		X	X	

A range of restoration actions are identified for three of the four neighborhoods. There were no actions identified for NSA_R_21 although buffer impacts were apparent within this neighborhood. Recommendations for addressing stormwater volume and pollutants within this subwatershed include: rain gardens, storm drain marking, Bayscapes and fertilizer reduction but vary for each neighborhood. In addition to the actions identified in Table 4-27, there are opportunities to address impacted buffers in NSA_R_6, NSA_R_16, and NSA_R_26. Figure 4-8 provides examples of typical development within this subwatershed.

Figure 4-8: Example of typical development type in Overshot Run (NSA_R_21 and NSA_R_26).

Hotspot Site Investigation

Two hotspots were assessed in the Overshot Run subwatershed (HSI_R_301, HSI_R_302). Both sites were identified as potential hotspots. The sites included a pool supply and maintenance business and retail establishment with no observable pollutants discharging from the site. The storage of outdoor materials, waste management and turf management may pose a concern. Specific actions identified of these hotspots are summarized in Table 4-28.

Table 4-28: Identified Actions for Hotspots Identified in Overshot Run

		Potential Pollution Sources					
Site ID	Type	Vehicle Operations	Outdoor Materials	Waste Mgmt	Physical Plant	Turf/Land-scaping	Stormwater
HSI_R_301	Retail		X	X	X	X	X
HSI_R_302	Pool Supply and Maintenance		X	X		X	

Institutional Site Investigation

Four institutional sites were assessed in the Overshot Run subwatershed with recommended actions identified for two sites (ISI_R_302 and ISI_R_303). A stormwater retrofit of the grassed swales is proposed for the park along with tree planting and storm drain marking. A stormwater retrofit is also recommended for a church to include a bioretention practice. A summary of potential actions are summarized in Table 4-29.

Table 4-29: Identified Actions for the Institutional Site in Overshot Run

		Identified Actions					
Site ID	Type	Tree Planting	Stormwater Retrofit	Downspout Disconnect-ion	Trash Mgmt.	Storm Drain Marking	Stream Buffer Improv.
ISI_R_301	School						
ISI_R_302	Park	260	X			X	
ISI_R_303	Church		X				
ISI_R_304	Church		X			X	

Pervious Area Assessment

An opportunity for a stormwater retrofit is present for a church property where the southern-most parking lot drains into a swale.

Stream Corridor Assessment

The 1997 Water Quality Management Plan for Loch Raven Watershed (Tetra Tech, 1997) included more than three miles of stream assessment in the Overshot Run subwatershed. Less than two percent of the assessed reaches ranked poor or very poor for channel stability.

Subwatershed Management Strategy

Restoration and protection strategies are outlined below.

<u>Engaging Citizens & Watershed Groups</u>

1. Promote awareness of the benefits of proper disposal of yard waste.
2. Increase homeowner awareness with proper buffer management in regulated areas (easements) to maintain existing and reforest impacted stream buffers with native plants, to include woody vegetation and removal of invasive vegetation.
3. Encourage citizens to adopt landscape practices to increase native vegetation and habitat and decrease turfgrass to include Bayscapes.
4. Inform citizens on the importance of septic system maintenance.
5. Engage citizens in a storm drain marking program and conduct marking activities in the neighborhoods.
6. Engage property owners in downspout disconnection onto adjacent impervious surfaces or into retrofitted rain barrels or rain gardens.

<u>Municipal Actions</u>

7. Identify opportunities to partner with local organizations and the garden club to assist with outreach efforts and to focus on organizations with an existing rain barrel or rain garden program/initiative.
8. Revisit stream reaches assessed for the 1997 Loch Raven study to re-evaluate stream conditions and recommend restoration actions as needed.
9. Conduct a retrofit assessment at two sites (ISI_R_302 and ISI_R_303). A stormwater retrofit of the grassed swales is proposed for the park along with tree planting and storm drain marking. A stormwater retrofit is also recommended for a church to include a bioretention practice.
10. Engage the Baltimore County Department of Recreation and Parks to identify areas for tree planting and opportunities for implementation at Sweet Air Park.
11. Investigate the effectiveness of existing deer management programs and potential additional deer management options.

12. Provide access to deer management information to homeowners.

4.3.6 Royston Run

Royston Run is one of the smallest subwatersheds within the Area R drainage area, located adjacent to the reservoir and having an area of just under one square mile (0.9 mi^2). The existing land use consists primarily of forest and low density residential land uses. Fifty-one percent of the land area is low or very low density residential development. Development peaked in the 1960s and 1970s, with smaller amounts of development built prior to and after this time period. There is 5 acres or 0.9% of the land area in conservation easement and is attributable to the absence of agricultural land in the subwatershed. Table 4-30 summarizes the key subwatershed characteristics of Royston Run.

Table 4-30: Royston Run Subwatershed Key Characteristics

Drainage Area	558.6 acres (0.9 mi^2)	
Stream Length	4.5 miles	
Total Population	368.8 (Census 2010) 0.7 people/acre	
Land Use/Land Cover	Very Low Density Residential (Agriculture):	0.1%
	Very Low Density Residential (Forested):	7.6%
	Low Density Residential:	44.1%
	Medium Density Residential:	0.0%
	Commercial:	0.0%
	Institutional:	0.0%
	Open Urban Land:	0.0%
	Agriculture(Cropland, Orchard, Pasture):	0.0%
	Forest:	45.1%
	Water and Wetlands:	3.1%
Land in Easement	5 acres (0.9%)	
Impervious Cover	5.4% per Subwatershed	
Hydrologic Soil Group	A soils B soils:	0.0% 88.4%

	C soils: D soils (high runoff potential):	11.6% 0.0%
SWM Facilities	None	
Restoration/Protection Priority Rating	Low/High	

Neighborhood Source Assessment

A total of 2 neighborhoods were identified and assessed within the Royston Run subwatershed during the uplands assessment of Area R. These neighborhoods are also located in the Greene Branch (NSA _R_18, NSA_R_ 17_20) and Overshot Run subwatersheds (NSA_R_ 17_20). A summary of the NSA for these neighborhoods are identified as part of the restoration and protection strategies for Greene Branch.

Hotspot Site Investigation

No hotspots were identified for this subwatershed.

Institutional Site Investigation

No institutional sites were identified for this subwatershed.

Pervious Area Assessment

No pervious areas were assessed for this subwatershed.

Stream Corridor Assessment

A stream corridor assessment was not completed for this subwatershed.

Subwatershed Management Strategy

Restoration and protection strategies are outlined below.

Engaging Citizens & Watershed Groups

1. Support actions identified for neighborhoods in Greene Branch and Overshot Run subwatersheds.

Municipal Actions

2. Continue county biological monitoring program.
3. Support MD DNR Stream Waders Program to identify a site for biological monitoring.

4. Support City of Baltimore efforts to protect and restore forested buffers on reservoir lands.
5. Investigate the effectiveness of existing deer management programs and potential additional deer management options.
6. Provide access to deer management information to homeowners.

CHAPTER 5.0
Plan Evaluation

5.1 Introduction

The Area R SWAP is based on a 12-year implementation schedule (2025 endpoint) that aligns with the timeframe for the Maryland pollutant reduction targets for the Chesapeake Bay TMDL. This timeframe is necessary to implement restoration measures and meet the Area R total phosphorus, fecal coliform, and sediment TMDLs. The ability to implement this plan within the 12-year timeframe is dependent upon the availability of staff and sufficient funding. The Area R SWAP Implementation Committee (an outgrowth of the Steering Committee) will meet twice per year to assess progress in meeting watershed goals and objectives and to discuss funding options. In addition, an annual progress report will be produced. The Chesapeake Bay TMDL is specifies pollutant load allocations and reduction targets by 2017 and 2025 in Maryland. Two-year milestones are established to track progress and ensure all practices are in place by 2025. The EPA will review the two-year milestones and determine if milestones are met using the Bay Tracking and Accountability System. An adaptive watershed management approach will be used to adjust actions as necessary based on implementation success. Progress and success of the Area R SWAP will be evaluated during implementation based on the following: interim measurable milestones, pollutant load reduction criteria, implementation tracking, and monitoring. These evaluation components are described in the following sections.

5.2 Interim Measurable Milestones

Performance measures have been developed for each action listed in Appendix A and will be used to gage the progress and success of proposed restoration strategies. The progress and success of actions in Appendix A will be evaluated on an annual basis. Action strategies may be modified and/or new actions may be proposed based on this annual evaluation. New actions proposed will also be evaluated on an annual basis and modified as necessary to meet watershed goals and objectives.

5.3 Pollutant Load Reduction Criteria

Current pollutant load reduction scenarios and calculations for proposed actions are presented in Chapter 3. These are mainly based on pollutant removal efficiencies approved by the Chesapeake Bay Program (CBP) for various nonpoint source BMPs. These pollutant removal efficiencies will continue to be used to measure progress in meeting the nutrient TMDL reduction goal (i.e., 50% reduction in total phosphorus loads from urban stormwater discharges). CBP-approved BMP removal efficiencies are summarized in the tables included as Appendix D. Actions and associated pollutant load reductions will be reevaluated if CBP revises/updates pollutant removal efficiencies within the action plan timeframe to ensure that the nutrient TMDL reductions are met.

5.4 Implementation Tracking

Implementation of restoration actions for the Area R SWAP will be overseen by the Implementation Committee. The committee will assess progress with individual actions related to the amount complete and the ease of implementation. Overall progress with meeting pollutant reductions will also be assessed. Adaptive management will allow the committee to discuss changes to the action schedule depending on the success of individual actions and the overall progress with the plan. If additional water quality issues arise, the SWAP implementation committee will initiate revisions of the plan.

5.5 Monitoring

Baltimore County currently conducts water quality monitoring programs within the Area R watershed. Additional monitoring is anticipated to assess the effectiveness of restoration projects and progress in meeting total phosphorus, bacteria, and sediment TMDL reductions.

Existing Monitoring

Several sources of monitoring data exist for the Area R watershed including Baltimore County and the Maryland Biological Stream Survey. These are described in detail in Appendix E, Chapter 3, Section 3.4 and listed below:

Baltimore County

- Trend Monitoring Program – One monitoring site in the Overshot Run subwatershed. Monthly samples are taken that measure nutrients, suspended solids, metals, chlorides, oxygen demand, temperature, pH, and discharge.
- Biological Monitoring Program – Randomly selected locations in the county to monitor benthic macroinvertebrates as a water quality indicator.
- Illicit Discharge Detection and Elimination Program – Routine outfall screening and prioritization system to track and reduce illicit connections and discharges.

Maryland Biological Stream Survey

- A statewide program that randomly selects locations to assess benthic macroinvertebrate and fish habitat conditions.

SWAP Implementation Monitoring

SWAP implementation monitoring activities will focus on project specific monitoring and targeted subwatershed monitoring. Project specific monitoring needs will be identified as restoration progresses. It will not be possible to monitor all restoration projects due to the number of actions proposed. Subwatershed monitoring will measure overall improvement in water quality as a result of multiple restoration activities within a subwatershed. This will also be developed as restoration progresses. There is potential to coordinate a citizen-based stream watch program. Monitoring activities will be coordinated among SWAP participants (Baltimore County and the Gunpowder Valley Conservancy) through participation in the Area R SWAP Implementation Committee.

APPENDIX A

Area R Action Strategies

This appendix presents the actions related to the goals and objectives presented in Chapter 2 of the Area R SWAP. The Goals and Objectives are summarized in Table A-1. A complete list of actions proposed for the watershed including timelines, performance measures, unit cost estimates, and responsible parties is included in Table A-2. In many cases, actions relate to multiple goals and objectives. Some of the key columns included in Table A-2 are briefly described below.

Goals and Objectives

Table A-1 indicates the goals and objectives targeted for each action. Each is further explained in Chapter 2 of the Area R SWAP.

Table A-1: Area R Goals and Objectives

Goal	Objectives
1. Improve and Maintain Stream Conditions	1. Meet TMDL goal to reduce bacteria by 80% for streams. 2. Remove the biological impairment for streams. 3. Conduct bacteria monitoring surveys to focus remediation efforts in the subwatersheds
2. Improve and Sustain a Safe and Reliable Drinking Water Supply	1. Meet TMDL goal to reduce phosphorus by 50% for the reservoir. 2. Meet TMDL goal to reduce sediment by 25% for the reservoir.
3. Protect High Quality Streams	1. Provide adequate forest buffers to protect 100 percent of the streams on public lands to support native fish populations.
4. Promote Environmentally Sensitive Development	1. Continue to apply Baltimore County's forest buffer regulations to enhance and protect streams. 2. Continue to apply the Forest Conservation Regulations 3. Reduce sediment runoff from construction sites by applying the enhanced erosion and sediment control requirements adopted November 17, 2012 by the County Council (Bill 72-12). 4. Enhance and protect natural resources. 5. Continue to use Environmental Site Design (ESD) guidance. 6. Maintain low density development in areas with good water quality
5. Support Land Preservation and Restoration to Sustain Healthy Trees and Forests	1. Support proper buffer management (e.g. tree planting, invasive plant removal) of contiguous forest patches with private and public land owners. 2. Increase native tree populations. 3. Promote restoration of natural habitats. 4. Reduce exotic invasive plants in forest areas on private and public

Goal	Objectives
	properties. 5. Encourage deer management to sustain healthy herd populations that reduces their negative impact on forest habitat and citizen enjoyment. 6. Maintain and restore the health of watershed forests and promote sustainable forest management. 7. Promote land conservation easements through local land trusts and county and state funding. 8. Encourage landowners to implement reforestation projects and to seek available funding.
6. Restore and Maintain Aquatic and Terrestrial Biodiversity	1. Restore and protect portions of the stream network, such that conditions can support diverse aquatic and riparian communities. 2. Protect and enhance trout habitat. 3. Manage deer populations to support diverse habitat and wildlife populations.
7. Promote Implementation of Conservation Practices on Agricultural Lands	1. Promote agricultural conservation/best management practices designed to improve water quality. 2. Inform the agricultural community on the need to improve the quality of stream buffers. 3. Encourage preservation and stewardship through conservation easements.
8. Increase Environmental Awareness	1. Effectively communicate the mission of the SWAP and the importance of a healthy watershed to community groups and leaders. 2. Promote conservation practices for homeowners, children, and institutions.
9. Support Environmentally-Friendly Recreation Opportunities	1. Increase awareness of safe and eco-friendly use of recreation opportunities. 2. Encourage golf courses to limit their environmental impact (e.g. Audubon Cooperative Sanctuary Program for Golf Courses (ACSP))

Actions

Actions developed to achieve watershed goals and objectives are grouped in Table A-2 according to the type of activity. Actions are grouped according to the following categories and subcategories:

- Restoration and Preservation
    - Clean Water
    - Stream Protection
    - Forest and Habitat
    - Agricultural Practices
    - Stewardship

    - Recreation
- Monitoring
- Funding
- Reporting

Basis for Performance Measure

This column describes the basis for performance measures developed for each action. Performance measures were developed using the information in this column in conjunction with the action timeline.

Timeline

This column denotes the timeline over which an action will be performed. Baltimore County set interim two-year milestones as part of the Chesapeake Bay Program TMDL. These milestones, or short-term goals, represent key check-in points for the county to track implementation progress, where 60% of the pollution reduction measures are in place by 2017 and 100% of the measures are in place by 2025. Table A-2 lists the recommended actions to achieve the current milestone period, ending June 30, 2015, and the balance to be achieved by 2025. Stream restoration and stormwater retrofits are not included in the first milestone period due to the involved planning that needs to occur prior to implementation of these types of projects. The first milestone period includes assessment-type of activity and development of outreach materials. The implementation committee will set goals for each two year period in the context of Baltimore County's Watershed Implementation Plan in the future.

Performance Measure

This column describes how the success/completion of a given action will be measured. In many cases, it is the numeric performance measure divided by the proposed timeline.

Unit Cost

Unit costs are used to develop overall cost estimates for proposed watershed action strategies (see Appendix B).

Responsible Party

Those responsible for ensuring the success/completion of a given action are denoted by a numeric code in this column. Responsible parties are indicated by numerals as follows:

1. Baltimore County (EPS)
2. Gunpowder Valley Conservancy (GVC)
3. Baltimore County Soil Conservation District
4. Area R SWAP Implementation Committee

Table A-2: Area R Action Strategies

Goal	Objective	Type[1]	Action	Basis for Performance Measure	Timeline		Performance Measure	Unit Cost	Responsible Party
					2015	2025			
RESTORATION AND PRESERVATION									
Clean Water									
2 6	1,2 1	P	Assess stream restoration opportunities recommended from the SCA and the 1997 Water Quality Management Plan.	Assessment of stream restoration opportunities.	2 years		Assessment completed	Existing staff	1
2 6	1,2 1	I	Complete stream restoration projects at feasible sites based on 1.5 miles of erosion recommended for restoration from the SCA and the 1997 Water Quality Management Plan.	Stabilize and restore 1.5 miles (7,791 linear feet) of unstable streams in Fitzhugh Run and Dulaney Valley Branch subwatersheds to provide water quality improvement X 75% participation = 5,843ft		6 years	Approx. 0.2 miles (1,000 linear feet) per year	$357/linear foot	1
1 6	1,2 1,2	P	Investigate additional SWM BMP opportunities within headwater or first order tributaries currently without appropriate SWM control.	Assessment of stormwater retrofit opportunities.	1 year	2 years	Investigation completed	Existing staff	1
1 2 6 8	1,2 1,2 1,2 1	P	Conduct stormwater retrofit assessments at all institutional sites and neighborhoods and work with property owners to identify options for implementation of the recommended actions.	Assessment of stormwater retrofit opportunities.	1 year	1 year	Assessments completed	Existing Staff	1
1 2 8	1,2 1,2 1	I	Design and implement stormwater retrofits at all feasible sites.	Field assessments identified 10 neighborhood retrofits + 4 faith-based institutional retrofits + 2 golf course retrofits X 50% participation rate = 8 stormwater retrofits. Additional assessment of stormwater retrofit opportunities as noted in the action strategy above may result in an adjustment to this initial estimate.		8 years	1 retrofit per year	$3,200/acre	1
1 2 8	1,2 1,2 1	I	Evaluate potential and implement regenerative stormwater conveyance (wet) practices at golf courses[2]	Stabilize 432 ft of streams as identified in institutional site assessment x 75% participation = approx. 320 ft		1 year	1 stream restoration project complete	$357/linear foot	1
4	3	P	Baltimore County shall continue to require and enforce sediment and erosion control practices for all new and redevelopment.	On-going.	On-going	On-going	Acres regulated	Existing staff	1
4	5	P	Baltimore County shall continue to implement stormwater management regulations that use ESD.	On-going.	On-going	On-going	# of ESD practices installed	Existing staff	1
Stream Protection									
1 3 6	1,2 1 1,2	P	Revisit stream reaches assessed as F and G channels in the 1997 Loch Raven study for Dulaney Valley Branch and recommend restoration actions as needed.	Provide recommended restoration actions.	1 year	1 year	Investigation completed	Existing Staff	1
1 2 6	1,2 1,2 1,2	P	Investigate stream restoration potential at the site in Fitzhugh Run, located southeast of the intersection of Jarrettsville Pike and Blenheim Road.	Provide an investigation of the stream restoration potential.	1 year		Investigation completed	Existing Staff	1
3 4 5 6	1 1,2,4 1,2,3,4,6 1,2	P	Baltimore County shall continue to require riparian buffers and forest conservation for all new and redevelopment. The County shall also continue to inspect and enforce existing forested buffers on residential easements.	On-going, keep track of existing riparian buffer and forest preserved.	On-going	On-going	Inspection every 2-5 years	Existing staff	1
Forest and Habitat									
1 2 3	1,2 1,2 1	I	Increase homeowner awareness with proper buffer management in regulated areas (easements) to reforest existing impacted stream buffers with native	Reforest 7 acres [3]of riparian open pervious land (residential) X 25% participation = 1.8 acres		9 years	Reforest 0.2 acre per year	$15,000/acre	1, 2

Goal	Objective	Type[1]	Action	Basis for Performance Measure	Timeline 2015	Timeline 2025	Performance Measure	Unit Cost	Responsible Party
5 6 8	1,2,3,4,6 1,2 1,2		plants to include woody vegetation.						
1 2 3 5 6 8	1,2 1,2 1 1,2,3,4,6,8 1,21,2	I	Create or enhance reforestation on upland open pervious land (currently not forested).	Reforest 50 acres[3] of upland open pervious land (residential) X 25% participation = 12.5 acres	1 years	10 years	Reforest 1 acre per year	$15,000/acre	1,2
5 8	2,3,4,6,8 1,2	I	Plant trees and implement downspout disconnection at institutional site.	Plant 200 trees and implement downspout disconnection x 50% participation		1 year	Plant 100 trees and disconnect downspouts	$175/tree,	1,
5 8 9	1,2,3,4,6 1 1	P	Engage the Baltimore County Department of Recreation and Parks to identify areas for tree planting at Sweet Air Park.	Identification of tree planting and implementation opportunities.	1 year		Identification complete	Existing staff	1,2
5 8	1,2,3,4,6 1,2	I	Work with Baltimore County Department of Recreation and Parks to plant trees at Sweet Air Park.	Plant 260 trees x 50% participation		1 year	Plant 130 trees	$175/tree	1
5 7 8	7 3 1,2	P	Support efforts of local and state non-profit organizations and agencies to protect forest interior and riparian habitat through conservation easements.	Continue to support parcels with critical forest in land preservation application review process.	On-going	On-going	Increase the amount of critical forest habitat under conservation easements	Existing Staff	1,2
1 2 5 6 8	1,2 1,2 1,2,3,4,6 1,2 1	P	Work with State DNR to identify opportunities to expand stream buffer within Gunpowder State Park	Provide an investigation of the stream buffer.	1 year		Investigation completed	Existing Staff	1
3 5 6	1 1,2,3,4,6 1,2	I	Maintain trees planted at forest buffer sites	Tree maintenance (watering, mowing, weeding, etc.) is required for the first 5 years to ensure successful growth; projected number of acres to be reforested: 57 acres.x 25% participation	On-going	On-going	Maintain 57 acres per year x 25% participation	$1,300/acre for 5 years	1,2
3 5 6	1 1,2,3,4,6 1,2	I	Maintain trees planted at institutional sites	Tree maintenance watering, mowing, weeding, etc.) is required for the first 5 years to ensure successful growth; project number of trees planted: 460 x 50% participation rate	On-going	On-going	Maintain 230 trees		
5	4,6	P	Improve forest habitat by organizing exotic invasive species removal activities every year.	Organize 1 exotic species removal activity addressing 2 acres per year.	On-going	On-going	Exotic species removed from 2 acres per year	$5,000	2
5 6	5 3	P	Support expansion of existing deer population management programs for protection of natural resources.	More effective deer herd management.	On-going	On-going	Reduced impact of deer on natural resources	Existing staff	1, 2, 3, 4
4	6	P	Continue support of downzoning for protection of natural resources.	Comment on zoning issues in support of natural resources.	On-going	On-going	Downzoning supported	Existing staff	1, 2, 3, 4
				Agricultural Practices					
7 8	1,2 1,2	P	Continue to work with the Baltimore County Soil Conservation District to increase Soil Conservation and Water Quality Plans (SCWQP)	Work with interested land owners, and generally promote use of SCWQP.	On-going	On-going	Support provided	Existing staff	1,3
7	3	P	Prioritize for conservation easements agricultural areas within the 2020 Master Plan designated	Agricultural preservation applications acknowledge APPA designation.	On-going	On-going	APPA prioritization in effect.	Existing staff	1

Goal	Objective	Type[1]	Action	Basis for Performance Measure	Timeline 2015	Timeline 2025	Performance Measure	Unit Cost	Responsible Party
			Agricultural Preservation Priority Areas (APPA).						
1 2 7 8	1,2 1,2 1 1	I	Install fencing and alternative watering for livestock operation.	Install 3,111 feet of fencing and alternative watering for livestock X 25% participation = 778 linear ft		8 years	Install 100 ft/year	$5/lf for fencing $6,000/site for off-stream watering	1,3
1 2 7	1,2 1,2 1,2	I	Restore stream buffer at feasible agricultural sites with a minimum width of 35 feet.	8.7 acres of open pervious land identified within the 100-foot stream buffer through GIS analysis X 25% participation rate = 2.2 acres.		2 years	Reforest 1 acre per year	$15,000/acre	1,2
			Stewardship						
2 5 8	1 2,3,4 1	P	Encourage citizens to adopt landscape practices to increase native vegetation and habitat and decrease turfgrass to include Bayscapes in the Area R neighborhoods.	Conduct Bayscaping awareness events targeting the Area R neighborhoods.	1 year	3 years	1 event every 3 years	$500/event	1,2
1 2 3 5 6 8	1,2 1,2 1,2 1,2,3,4,6 1,2 1,2	P	Increase homeowner awareness with proper buffer management in regulated areas (easements), remove invasive vegetation and plant native plants	Maintain existing buffers and remove invasive vegetation	On-going	Occasional	1 event every 3 years	$500/event	1,2
1 2 8	1, 2 1 1	I	Disconnect downspouts at institutional site.	Work with property owners to disconnect approximately 4 downspouts to pervious open space. Rain barrels may be an option for confined space		1 year		$15/downspout disconnection	2
2 8	1,2 1	P	Promote awareness of the benefits of proper disposal of yard waste.	Publicize several actions in E-News Stream and MD extension service's "Branching Out" and other media	On-going	On-going	1 announcement per year	Existing staff	1
1 2 8	1,2 1 1	P	Inform citizens on the importance of septic system maintenance based on the estimated 2,500 existing systems.	Conduct septic system maintenance awareness events	1 year	3 years	1 event every 3 years	$500/event	1
1 2 8	1,2 1,2 1	I	Engage citizens in a storm drain marking program and conduct marking activities in the 23 recommended neighborhoods.	Work with community groups or institutions to install storm drain markers in the 23 neighborhoods identified.	2 years	3 years	5 neighborhoods per year	$400/neighborhood	1,4
2 8	1,2 1	P	Engage property owners in downspout disconnection onto adjacent impervious surfaces or into retrofitted rain barrels or rain gardens.	Conduct rain garden/rain barrel events		9 years	1 event every 3 years	$500/event	1,2,4
8	1	P	Develop awareness materials for commercial businesses on proper waste management and disposal.	Awareness materials developed	2 years	Materials available, on-going	Materials available for distribution (handout and online)	$500 for materials	1
1 2 6 8 9	1,2 1,2 1,2 1,2 1	P	Continue to participate in “Dam Jam” to promote stewardship actions, specifically yard waste, stormwater and buffer management.	Participation in “Dam Jam”	On-going	On-going	1 event per year	Existing staff	1, 2
8	1	P	Promote awareness of the stream watch Adopt-a-Stream program and MD DNR Stream Waders program, with specific focus on filling in the gaps for	Adopt a section of stream within Area R and solicit volunteers to sample sites through the Stream Waders program	On-going	On-going	Host 2 events per year	$500/event	2

Goal	Objective	Type[1]	Action	Basis for Performance Measure	Timeline		Performance Measure	Unit Cost	Responsible Party
					2015	2025			
			biological monitoring.						
2 8	1,2 2	P	Form partnerships with institutions and discuss the BMP recommendations from the institutional assessments and implementation options.	5 institutions assessed with potential for stormwater management retrofit.	2 years	3 years	1 institution per year	Existing staff	1
RECREATION									
9	1	P	Support City of Baltimore actions to enhance environmentally-responsible recreational opportunities within the Loch Raven Reservoir.	Maintain collaborative relationship regarding protection of the drinking water reservoirs.	On-going	On-going	Support provided	Existing staff	1
9	2	P	Encourage golf courses to seek Audubon Cooperative Sanctuary Program (ACSP) certification.	Develop and host a workshop.	2 years	n/a	Workshop held	Existing staff	1, 2, 4
9	1	P	Increase awareness of zebra mussel prevention for the reservoir.	Expand upon/develop outreach materials to target boaters.	2 years	On-going	Materials developed and distributed	Existing staff	1
9	1	P	Increase awareness of didymo (invasive algae) prevention for streams.	Expand upon/develop outreach materials to target people who fish.	2 years	On-going	Materials developed and distributed	Existing staff	1
MONITORING									
2 3 6	1,2 1 1,2	P	Complete SCAs in Jenkins Run, Greene Branch, Overshot Run, and Royston Run.	Completed SCAs	2 years	2 years	1 subwatershed SCA per year	Existing Staff	1
1	1,2	P	Identify subwatersheds that have E. Coli concentrations above WQ standards.	Sample for bacteria in the subwatersheds.	1 year	1 year	Investigation completed and problem areas identified	Existing staff	1
1 2	1,2 1,2	P	Conduct inspection of BMPs and provide on-going maintenance for all public facilities.	Assure that each facility is inspected every 3 years.	On-going	On-going	Inspections completed	Existing staff	1
6	1,2	P	Continue County biological monitoring program.	Biological monitoring stations in Area R are monitored in even numbered years and a report produced.	Even numbered years	Even numbered years	Stations monitored, report produced	Existing staff	1
2	1,2	P	Develop a method to measure and monitor properties that do not apply fertilizer.	Provide an accounting of nutrient reductions.	1 year	4 years	Monitoring protocols developed for fertilizer use	Existing staff	1, MDA
6	1	P	Continue to monitor the fish populations in coordination with DNR.	Annual monitoring.	On-going	On-going	Annual Monitoring	Existing staff	1, DNR
FUNDING									
2	1,2	P	Coordinate grant funding requests to secure funding and implement restoration and protection projects to meet TMDL nutrient reduction requirements.	Seek a minimum of 1 grant every 3 years to meet the TMDL requirements within 12 years.		10 years	1 grant proposal every 3 years	Existing staff	1,2,3,4
5	8	P	Promote awareness of reforestation funding opportunities for land owners.	Publicize funding sources for reforestation on private property in E-News Stream and MD extension service's "Branching Out" and other media .	On-going	On-going	Landowners apply for funding	Existing staff	1, 2
REPORTING									
All	All	P	Area R SWAP Implementation Committee will meet to discuss implementation progress and assess any changes needed to meet the goals.	Meet on a semi-annual basis.	On-going	On-going	2 meetings per year	Existing staff	4
All	All	P	Report restoration progress.	NPDES annual report.	On-going	On-going	NPDES annual report	Existing staff	1, 2
All	All	P	Develop a SWAP progress report template.	Template created.	2 years		SWAP Progress Report	Existing staff	1
All	All	P	Update SWAP progress report.	Update annually.	On-going	On-going	SWAP Progress Report	Existing staff	1

[1]Project type denotes programmatic (P) or implementation (I) projects. The programmatic elements are tracked on a calendar year (January 1st through December 31st). The implementation projects are tracked on a fiscal year (July 1st through June 30th).
[2] Regenerative Stormwater Conveyance (Wet) is a stream restoration BMP and is reported to the Chesapeake Bay Program for TMDL-purposes as part of stream restoration projects
[3] The 7 acres and 50 acres of stream buffer reforestation is estimated from the Baltimore County WIP and prorated to the Area R watershed area. This estimate is not based on the 752 acres presented in Chapter 3, Table 3-22

APPENDIX B

U.S. Environmental Protection Agency A Through I Criteria for Watershed Planning

The Clean Water Act (CWA) was amended in 1987 to establish Section 319 Nonpoint Source Management Program, after recognizing the need for federal assistance with focusing state and local nonpoint source efforts. Under this section, states, tribes, and territories can receive grant money for the development and implementation of programs aimed at reducing nonpoint source (NPS) pollution. NPS pollution comes from many different sources and is a result of human activities on the land. It is caused by pollutants from human activities and atmospheric deposition that are deposited on the ground and eventually carried to receiving waters by stormwater runoff. Common NPS pollutants and sources include:

- Excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas
- Oil, grease, and toxic chemicals from urban runoff and energy production
- Sediment from improperly managed construction sites, crop and forest lands, and eroding stream banks
- Salt from irrigation practices and acid drainage from abandoned mines
- Bacteria and nutrients from livestock, pet wastes, and failing septic systems

CWA Section 319 grant funds can be requested to support various activities such as technical assistance, financial assistance, education, training, technology transfer, restoration projects, and monitoring to assess the success of specific nonpoint source implementation projects. Watershed-based plans to restore impaired water bodies and address nonpoint source pollution using incremental Section 319 funds must meet USEPA's A through I criteria for watershed planning:

This appendix will provide information on how the development of the Area R Small Watershed Action Plan addresses the USEPA A through I criteria for watershed planning. It will serve as a guide to the location within the document, including appendices, where each criterion is addressed. Table B-1 provides the location information for each of the A through I Criteria and describes how the document meets the Criteria.

The list below provides a description of each element of the EPA Watershed Planning Criteria.

a) *An identification of the causes and sources, or groups of sources, that will need to be controlled to achieve the load reductions estimated in the watershed plan*

b) *Estimates of pollutant load reductions expected through implementation of proposed nonpoint source (NPS) management measures*

c) *A description of the NPS management measures that will need to be implemented*

d) *An estimate of the amount of technical and financial assistance needed to implement the plan*

e) *An information/education component that will be used to enhance public understanding and encourage participation*

f) *A schedule for implementing the NPS management measures*

g) *A description of interim, measurable milestones for the NPS management measures*

h) *A set of criteria to determine load reductions and track substantial progress towards attaining water quality standards*

i) *A monitoring component to evaluate effectiveness of the implementation records over time*

Table B-1 is a guide to the location within the document, including appendices, where each criterion is addressed.

Table B-1: Where to Locate Information for Each USEPA's A-I Criteria Element

Chapter of the Report	USEPA A-I Criteria								
	A	B	C	D	E	F	G	H	I
Chapter 1. Introduction					X				
Chapter 2. Vision, Goals and Objectives					X				
Chapter 3. Restoration Strategies		X	X		X				
Chapter 4. Subwatershed Management Strategies	X		X		X				
Chapter 5. Plan Evaluation				X		X	X	X	X
Appendix A. Area R Action Strategies			X	X	X	X	X		X

Chapter of the Report	USEPA A-I Criteria								
	A	B	C	D	E	F	G	H	I
Appendix B. U.S. Environmental Protection Agency A Through I Criteria for Watershed Planning									
Appendix C. Cost Analysis and Potential Funding Sources				X					
Appendix D. Chesapeake Bay Program Pollutant Load Reduction Efficiencies		X							
Appendix E. Area R Watershed Characterization Report	X		X		X				
Appendix F. Stream Corridor Assessment Survey Data	X								
Appendix G. Uplands Survey Data	X								
Appendix H. Synoptic Survey	X								
Appendix I. Total Maximum Daily Load - Mercury	X								
Appendix J. Total Maximum Daily Load - Bacteria	X								
Appendix K. Total Maximum Daily Load – Phosphorus and Sediment	X								
Appendix L. Biological Assessment	X								

The following provides a discussion on how the development of the Area R Small Watershed Action Plan addresses the US Environmental Protection Agency (USEPA) A through I criteria for watershed planning. It serves as a guide to the location within the document, including the appendices, where each criterion is addressed.

a. An identification of the causes and sources, or groups of sources, that will need to be controlled to achieve the load reductions estimated in this watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan), as discussed in item (b) below.

The Loch Raven Reservoir watershed (8-digit watershed) is listed as impaired in the Maryland 303(d) list of impaired waters for various pollutants of concern including: fecal coliform, methylmercury, sedimentation and siltation, total phosphorous and impacts to benthic/fish communities (MDE, 2008). The Loch Raven Reservoir impoundment is impaired for sedimentation and siltation, methylmercury, and total phosphorus. The Loch Raven Reservoir watershed streams are impaired for impacts to benthic and fish communities (first through fourth order streams) and fecal coliform (mainstem river).

Four TMDLs have been completed and approved for the Loch Raven Reservoir watershed. In the Area R subwatersheds, the impairment that is most relevant is the impact on benthic/fish communities in first through fourth order streams. According to MDE the stream biological community impairment listing has a low priority and a TMDL will be developed at some point in the future (MDE, 2008). While the impairment documented in Area R subwatersheds is a lower priority, it may also be contributing to the downstream impairments in the river mainstem and the reservoir impoundment. In addition, it is important that measures are taken in Area R to help meet the TMDLs for phosphorous, sediment and fecal coliform, which are a problem in the reservoir and mainstem river. These TMDL documents can be found in Appendix I.

In addition, to further refine the sources of pollutants, upland source assessments and stream corridor assessments were performed. The upland assessment results are presented in Appendix E, Chapter 4. The stream corridor assessment results are presented in Appendix E, Chapter 3.

Further analysis of pollution sources are provided by a GIS analysis of potential landscape indicators of pollution presented in Appendix E, Chapter 2. Further pollutant load analysis is provided in Appendix E, Chapter 3.3.

b. An estimate of the load reductions expected for the management measures described under paragraph (c) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time). Estimates should be provided at the same level as in item (a) above (e.g., the total load reduction expected for dairy cattle feedlots; row crops; or eroded streambanks).

Expected nitrogen and phosphorus load reductions were based on the EPA - Chesapeake Bay Program load reduction criteria used in their Phase 5.3 model for the water quality impairments of the non-tidal Chesapeake Bay and the Baltimore County Agricultural Reduction Summary Table. These load reductions are presented in Appendix D. Using the information in Appendix D, the nitrogen and phosphorus load reductions for the various actions were calculated and summarized in Chapter 3 (Table 3-17).

c. A description of the NPS management measures that will need to be implemented to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this watershed-based plan), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.

The management measures that will need to be implemented to achieve the goals are detailed in Appendix A. Information on the achievement of the phosphorus and nitrogen reduction goals is provided in Chapter 3.5. Chapter 4 details the management measures for each subwatershed in the SWAP study area.

d. An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and the authorities that will be relied upon, to implement this plan. As sources of funding, States should consider the use of their 319 programs, State Revolving Funds, USDA's Environmental Quality Incentives Program and

Conservation Reserve Program, and other relevant Federal, State, local and private funds that may be available to assist in implementing this plan.

Appendix C provides the cost analysis and the anticipated funding sources to implement the actions. Appendix A details the anticipated cost for each action on an annual or unit basis and details the organizations that will be responsible for implementation of the each action.

e. An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the NPS management measures that will be implemented.

The educational activities to enhance public understanding and encourage participation in restoration implementation planning and the installation of best management practices are detailed in Appendix A. Chapter 3.4 details specific education/awareness focus areas, and Chapter 4 details specific education/awareness activities for each subwatershed.

f. A schedule for implementing the NPS management measures identified in this plan that is reasonably expeditious.

A schedule for each activity is provided in Appendix A. It is anticipated that the restoration will require a 9-year timeframe. Some actions have a shorter time frame based on sequencing of actions, or on the urgency of the actions. However, most management measures have annual performance measures that will determine if the restoration is on pace to be completed within the time frame. The limitations on the pace of the implementation include staffing, and funding. Increases in staffing and funding will be used to accelerate the restoration timeline. Chapter 5 presents an adaptive management approach to implementation.

g. A description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented.

Appendix A provides the annual interim measurable milestones for determining the implementation status of the NPS management measures. In addition, semi-annual meetings with the implementation committee will update the status on implementation progress.

h. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards, and, if not, the criteria for determining whether this watershed based plan needs to be revised or, if a NPDES TMDL has been established, whether the NPS TMDL needs to be revised.

The load reductions due to the restoration activities will be calculated via a spreadsheet using the EPA Chesapeake Bay Program – Best Management Practice Pollutant Reduction Efficiencies (Appendix D). These efficiencies will be used in conjunction with the implementation tracking to calculate the load reductions being achieved. The efficiencies used will be modified based on any modifications of the EPA Chesapeake Bay Program efficiencies.

i. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

Chapter 5 details the monitoring that will occur to evaluate the effectiveness of implementation. The monitoring results will be compared to the predicted load reductions determined under item (*h*) above.

APPENDIX C

Cost Analysis and Potential Funding Sources

Cost estimates and potential funding sources for the implementation of proposed restoration BMPs for the Area R SWAP are described below.

Cost Analysis

The cost analysis is based on the actions detailed in Appendix A. Table C-1 presents cost estimates based on the implementation scenario described in Chapter 3 with the goal of achieving the 50 percent reduction in total phosphorus loads from urban runoff, also described in Chapter 3. For this scenario, estimates represent total cost estimates for the anticipated implementation timeframe for the Chesapeake Bay total maximum daily load (TMDL) of 2025. Unit costs are based on a combination of local information and previous SWAPs completed for other local watersheds (e.g., Upper Gwynns Falls). BMP costs are not annualized over the implementation timeframe and do not include costs of existing staff. Costs are also presented in dollars per pound of nitrogen and phosphorus removal for those BMPs where pollutant removal calculations are possible (refer to Chapter 3). This provides an additional tool for the assessment and selection of BMPs. The total cost of maximum implementation (i.e., 100% participation) exclusive of staffing costs is estimated at $4,237,311. The estimated cost for implementation given the projected participation level for each BMP through 2015 is $126,355 with the balance of the costs incurred through 2025. The estimated cost for the first milestone period are low as the costs for project implementation such as stream restoration, stormwater retrofits are planned for subsequent milestone periods (i.e., post 2015).

Potential Funding Sources

Funding sources for the implementation of the Area R SWAP include local government funding for Baltimore County, monetary and time contributions from the Area R SWAP Implementation Committee, and various grants as described below.

Baltimore County uses general funds and the stormwater remediation fee to support staff, whose responsibility is to monitor and improve water quality through implementation of various programs including capital restoration projects. Baltimore County has a Watershed Restoration Capital Program that is funded by a combination of general funds, bonds, stormwater remediation fee, metropolitan funds, and grants. Approximately $16 million per year is allocated for environmental restoration projects throughout the county. Additional general funds and stormwater remediation fee funds are used by the Baltimore County Department of Public Works to support stormwater infrastructure remediation, street sweeping, stormdrain system cleaning, and retrofitting county property subject to the general industrial stormwater discharge permit. Baltimore County provides grants to local watershed organizations through its Watershed Association Citizen Restoration Planning and Implementation Grant Program. These funds provide staffing for restoration project implementation, and education and outreach programs.

Baltimore County also aggressively seeks grant funding from federal and state funding sources to supplement our restoration efforts.

In order to implement all of the actions listed in Appendix A and to meet the anticipated funding needs summarized in Table C-1, additional funding from grants will be required. Table C-2 presents potential funding sources to support the implementation of the Area R SWAP including funding source, applicant eligibility, eligible projects, funding amount, cost share requirements, and grant cycle. The anticipated major grant funding sources include the following:

- **The Chesapeake and Atlantic Coastal Bays Trust Fund:** The Trust Fund was established to provide financial assistance to local governments and political subdivisions for the implementation of nonpoint source pollution control projects. These are intended to achieve the state's tributary strategy developed in accordance with the Chesapeake 2000 Agreement and to improve the health of the Atlantic Coastal Bays and their tributaries. The BayStat Program directs the administration of the Trust Fund, with multiple state agencies receiving moneys, including Maryland Department of Environment (MDE), Department of Natural Resources (DNR), Maryland Department of Agriculture (MDA), and Maryland Department of Planning (MDP). http://www.dnr.maryland.gov/ccs/funding/trust_fund.asp

- **319 Non-point Pollution Grants:** Federal money for restoration implementation is available annually through MDE. http://www.mde.state.md.us/programs/Water/319NonPointSource/Pages/Programs/WaterPrograms/319nps/factsheet.aspx

- **Bay Restoration Fund (MDE):** This is a dedicated fund, financed by wastewater treatment plant users, to upgrade Maryland's wastewater treatment plants with enhanced nutrient removal technology. In addition, a similar fee paid by septic system users is utilized to upgrade onsite systems and to pay for cover crops to reduce nitrogen loading to the bay. Proposed modifications to the fund will allow the fund to be used for implementation of stormwater restoration projects. http://www.mde.state.md.us/programs/Water/BayRestorationFund/Pages/index.aspx

- **Water Quality Revolving Loan Fund (MDE):**
  Provides low interest loans to local governments to finance waste water treatment plant upgrades, non-point source projects, and other water quality and public health improvement projects. http://www.mde.state.md.us/programs/Water/QualityFinancing/Pages/Programs/WaterPrograms/water_quality_finance/index.aspx

- **Linked Deposit (MDE):** The Linked Deposit mechanism was designed to provide a source of low interest financing to encourage private landowners to implement capital improvements that will reduce delivery of nutrients to the Chesapeake Bay and its tributaries.

http://www.mde.state.md.us/programs/Water/QualityFinancing/LinkedDeposit/Pages/Programs/WaterPrograms/Water_Quality_Finance/link_deposit/index.aspx

- **Innovative Nutrient and Sediment Reduction Program (National Fish and Wildlife Foundation):** The National Fish and Wildlife Foundation (NFWF), in partnership with U.S. Environmental Protection Agency (USEPA) and the Chesapeake Bay Program, will award grants on a competitive basis to support the demonstration of innovative approaches to expand the collective knowledge about the most cost-effective and sustainable approaches to dramatically reduce or eliminate nutrient and sediment pollution to the Chesapeake Bay and its tributaries.

- **Chesapeake Bay Stewardship Fund:** The goal of the Chesapeake Bay Stewardship Fund is to accelerate local implementation of the most innovative, sustainable and cost-effective strategies to restore and protect water quality and vital habitats within the Chesapeake Bay watershed. The Stewardship Fund offers four grant programs: the Chesapeake Bay Small Watershed Grant Program; the Chesapeake Bay Targeted Watersheds Grant Program; the Chesapeake Bay Conservation Innovation Grant Program; and the Innovative Nutrient and Sediment Reduction Program. Major funding for the Chesapeake Bay Stewardship Fund comes from the USEPA, the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), the U.S. Department of Agriculture Forest Service (USFS), and the National Oceanic and Atmospheric Administration (NOAA).
http://www.nfwf.org/chesapeake/Pages/home.aspx

- **MD State Highway Administration (SHA) Transportation Alternatives Program (TAP): As part of the Federal Highway Administration Surface Transportation Program, the TAP** is a reimbursable, federal-aid funding program for transportation-related community projects designed to strengthen the intermodal transportation system. The program assists in funding projects that create bicycle and pedestrian facilities, restore historic transportation buildings, convert abandoned railway corridors to pedestrian trails, mitigate highway runoff, and other transportation related enhancements. The program requires a sponsor to fund 20% of the project cost. TAP funding can be requested for up to half of a project's total estimated cost.
http://roads.maryland.gov/index.aspx?pageid=144

- **Chesapeake Bay Trust:** Provides grants through a variety of grant programs that focus on environmental education, urban greening, fisheries, and remediation of water quality issues. Specifically, the Targeted Watershed Grant Program provides funding for on-the ground solutions that address the most pressing nonpoint source pollution challenges facing a small watershed, and that result in measurable improvements in water quality and wildlife habitat. The program also seeks to support cost effective approaches to Chesapeake Bay restoration actions at the small watershed scale and establish a replicable model of restoration that can be transferred and used throughout the region.
http://www.cbtrust.org/site/c.miJPKXPCJnH/b.5457271/k.C58E/Grants.htm

- **Natural Resources Conservation Service:** The US Department of Agriculture Natural Resources Conservation Service (NRCS) provides financial assistance to landowners to protect and conserve natural resources. The programs are voluntary to eligible landowners and agricultural producers**.** NRCS delivers conservation technical assistance through its voluntary Conservation Technical Assistance Program (CTA). CTA is available to any group or individual interested in conserving our natural resources and sustaining agricultural production in this country http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/

- **Maryland Department of Agriculture:** The Maryland Agricultural Water Quality Cost-Share (MACS) Program provides farmers with grants to install BMPs on their farms to prevent soil erosion, manage nutrients and safeguard water quality in streams, rivers and the Chesapeake Bay. More than 30 BMPs are currently eligible for MACS grants. http://mda.maryland.gov/resource_conservation/Pages/macs.aspx

Table C-1: Maximum Estimated Costs for Area R SWAP Implementation

BMP or Action	Cost	Unit	Quantity	Project Total Cost	Project TN Load Reduction (lbs)	Project Cost/lb of TN Removal	Project TP Load Reduction (lbs)	Project Cost/lb of TP Removal
Urban BMP								
Promote Bayscaping	$500	/event	4	$2,000.00	n/a	n/a	n/a	n/a
Residential Buffer Management	$500	/event	4	$2,000.00	n/a	n/a	n/a	n/a
Stream Restoration (incl. RSC wet)[1]	$357	/linear feet	8,223	$2,935,539.60	1644.6	$1,784.96	559.2	$5,249.53
Adopt-a-Stream Program Events	$500	/event	24	$12,000.00	n/a	n/a	n/a	n/a
SWM Retrofits	$3,200	/acre	12.1	$38,720.00	131.0	$295.57	12.7	$3,048.82
Urban Stream Buffer Reforestation	$15,000	/acre	57	$855,000.00	659.0	$1,297.42	26.7	$32,022.47
Institutional Tree Planting	$175	/tree	460	$80,500.00	20.2	$3,985.15	0.6	$134,166.67
Institutional Downspout Disconnection	$15	/disconnection	2	$30.00	n/a	n/a	n/a	n/a
Stream Buffer/Tree Maintenance[2]	$1,300	/acre	59	$76,700.00	n/a	n/a	n/a	n/a
Septic System Maintenance Events	$500	/event	4	$2,000.00	n/a	n/a	n/a	n/a
Exotic Species Removal Event	$5,000	/event	1	$5,000.00	n/a	n/a	n/a	n/a
Citizen Storm Drain Marking	$400	/neighborhood	23	$9,200.00	n/a	n/a	n/a	n/a
Promote Residential Downspout Disconnection	$500	/event	3	$1,500.00	n/a	n/a	n/a	n/a
Urban Nutrient Management	TBD	/acre	3,061	TBD	1833.0	TBD	229.6	TBD
Engage Commercial Properties on Proper Waste Disposal	$500	/event	12	$6,000.00	n/a	n/a	n/a	n/a
Agriculture BMPS								
Soil and Water Conservation Plans	TBD	/acre	232		216.9		32.6	
Fencing	$4.70	/linear feet	3,111.00	$14,621.70	16.8	$870.34	2.2	$6,646.23
Alternative Stream Watering	$6,000.00	/site	TBD	TBD				
Agriculture Forested Buffer	$15,000	/acre	8.7	$130,500.00	249.9	$522.21	16.9	$30.90
Nutrient Management Plan	TBD	/acre	166.3	TBD	517.2	TBD	49.9	TBD
County-wide								
State of Our Watersheds Report	$11,000	/biannual	6	$66,000.00	n/a	n/a	n/a	n/a
			TOTAL	$4,237,311.30				

[1] Regenerative Stormwater Conveyance (RSC) - wet is reported as a stream restoration BMP to Chesapeake Bay Program

[2] Assumes 2 acres for the 460 trees planted on institutional sites

Table C-2:Projected Estimated Costs for Area R SWAP Implementation for 2015

BMP or Action	Cost	Unit	Projected Par-ticipation	Cumulative Projected Quantity 2025	Projected Quantity 2015	2015 Project Total Cost	Project TN Load Reduction (lbs)	Project Cost/lb of TN Removal	Project TP Load Reduction (lbs)	Project Cost/lb of TP Removal
Urban BMP					*Project 2015 Milestone Implementation*					
Promote Bayscaping	$500	/event	100%	4	1	$500.00	n/a	n/a	n/a	n/a
Residential Buffer Management	$500	/event	100%	4	1	$500.00	n/a	n/a	n/a	n/a
Stream Restoration [1]	$357	/linear feet	75%	6,167	0	$0.00	0.00	$0.00	0.00	$0.00
Adopt-a-Stream Program Events	$500	/event	100%	24	4	$2,000.00	n/a	n/a	n/a	n/a
SWM Retrofits	$3,200	/acre	50%	6	0	$0.00	0.00	$0.00	0.00	$0.00
Urban Stream Buffer Reforestation	$15,000	/acre	25%	14	4	$60,000.00	46.25	$1,297.42	1.87	$32,022.47
Institutional Tree Planting[2]	$175	/tree	50%	230	0	$0.00	0.00	$0.00	0.00	$0.00
Institutional Downspout Disconnection	$15	/disconnection	100%	2	0	$0.00	n/a	n/a	n/a	n/a
Buffer Maintenance	$1,300	/acre	25%	15	4	$5,200.00	n/a	n/a	n/a	n/a
Septic System Maintenance Events	$500	/event	100%	4	1	$500.00	n/a	n/a	n/a	n/a
Exotic Species Removal Event	$5,000	/event		TBD	1	$5,000.00	n/a	n/a	n/a	n/a
Citizen Storm Drain Marking	$400	/neighborhood	100%	23	10	$4,000.00	n/a	n/a	n/a	n/a
Promote Residential Downspout Disconnection	$500	/event	100%	3	1	$500.00	n/a	n/a	n/a	n/a
Urban Nutrient Management	TBD	TBD	100%	3,061	3,061.00	TBD	1,833.00	TBD	229.60	TBD
Engage Commercial Properties on Proper Waste Disposal	$500	/event	100%	12	1	$500.00	n/a	n/a	n/a	n/a
Agriculture BMPS										
Soil and Water Conservation Plans	TBD	/acre	50%	116						
Fencing	$4.70	/linear feet	25%	778	777.8	$3,655.66	4.20	$870.34	0.55	$6,646.23
Alternative Stream Watering	$6,000	/site	25%	TBD		TBD				
Agriculture Forested Buffer	$15,000	/acre	25%	2.2	2.2	$33,000.00	62.48	$528.21	4.23	$125.02
Nutrient Management Plan	TBD	/acre	100%	166	166.3	TBD	517.20	TBD	49.90	TBD
County-wide										
State of Our Watersheds Report	$11,000	/biannual	100%	6	1	$11,000.00	n/a	n/a	n/a	n/a
					TOTAL	$126,355.66				

[1] Regenerative Stormwater Conveyance (RSC) - wet is reported as a stream restoration BMP to Chesapeake Bay Program

[2] Assumes 2 acres for the 460 trees planted on institutional sites

Table C-3: Area R SWAP Potential Funding Sources

Managing Agency	Funding Source	Applicability Eligibility	Eligible Projects Funding Amount	Funding Amount	Cost Share In-Kind	Project Period
American Forests	Global ReLeaf Program (American Forests)	All public land or public accessible lands Local government State government	Public Lands Restoration Projects which include local organizations; use innovative restorative practices with potential for general application; minimum 20 acre project area	Average funding amount $3,000 to 30,000 200 to 700 trees/acre planted	Covers tree planting costs In-Kind: Yes	1 year
Chesapeake Bay Trust	Targeted Watershed Initiative Grant Program	Non-profits 501(c) Institutions Soil/Water Conservation Districts Local government	Involve local organizations; address non-point source pollution; projects related to water quality and habitat restoration	$50 to $20,000	No cost-share In-Kind: Yes	1- 2 years
Chesapeake Bay Trust	Capacity Building Initiative Grant Program	Non-profit 501(c) with a board on which half the members participate meaningfully and at least one paid staff (or a part-time paid volunteer)	Strengthen an organization through management operations, technology, governance, fundraising and communications	$15,000/year	No cost-share In-Kind: No	3 years
Chesapeake Bay Trust	Stewardship Grant Program	Non-profits 501(c) Schools/universities Soil/Water Conservation Districts Local government State government	Raise awareness about watershed restoration; design plans which educate citizens on things they can do to aid watershed restoration; educate students about local watersheds, projects geared towards watershed restoration and protection	$5,000 to $25,000	No cost-share In-Kind: No	1 year
Department of Natural Resources	Clean Water Action Plan Nonpoint Source Program 319 Grant	Non-profits 501(c) Universities Soil/Water Conservation Districts Local government	Located in a Category I and Category III watershed as outlined in the MD unified watershed assessment; establish cover crops; address stream restoration and riparian buffers	$5,000 to $40,000	40%	Annual
Maryland Department of Environment	Bay Restoration Fund Nitrogen-Reducing Septic Upgrade Program	Local governments	Fund prioritizes upgrades as follows: Failing OSDS in the Critical Areas 1) Failing OSDS outside the Critical Areas ; 2) Non-conforming OSDS in the Critical Areas; 3) Non-conforming OSDS outside the Critical Areas; 4) Other OSDS in the Critical Areas	Income-based grant funding	Up to 50% cost share In-Kind: No	Annual

			including new construction ; 5) Other OSDS outside the Critical Areas, including new construction			
National Fish and Wildlife Foundation	Chesapeake Bay Small Watersheds Grant Program	Non-profits 501(c) Local government	Community-based projects that improve the condition of local watersheds while building stewardship among citizens, watershed restoration, conservation and planning	\$20,000 to \$200,000	25%	1-5 years
National Fish and Wildlife Foundation	Chesapeake Bay Targeted Watersheds Grant Program	Non-profits 501(c) Universities Local government State government	Innovative demonstration type restoration projects	\$400,000 to \$1,000,000	25% In-Kind: Yes	2-3 years
USEPA	Targeted Watersheds Grant Program – Capacity Building Grant Program	Non-profits 501(c) Universities Local government State government	Promote organization development of local watershed partnerships; Provide training and assistance to local watershed groups	\$400,000 to \$800,000	25% In-Kind: Yes	2 years
USEPA	Targeted Watersheds Grant Program – Implementation Grant Program	Non-profits 501(c) Universities Local government State government	Watershed restoration and, or protection projects; Projects must include a monitoring component	\$600,000 to \$900,000	25% In-Kind: Yes	3-5 years
Maryland Department of Agriculture	Agricultural Water Quality Cost-Share (MACS) Program	An applicant may be an individual, partnership, corporation, trust, or other business enterprise where an owner, landlord, or tenant participates in the operation of a farm.	Grants to cover up to 87.5 percent of the cost to install conservation measures known as best management practices (BMPs) on their farms to prevent soil erosion, manage nutrients and safeguard water quality in streams, rivers and the Chesapeake Bay	Up to 87.5% of the cost of BMP	12.5%	Annual
Natural Resources Conservation Service	Variety of financial and technical assistance programs	Eligibility is program specific and generally open to private land owners and agricultural produces	Technical assistance and cost share programs to enroll land in conservation easements, install erosion control practices, enhance wildlife and fish habitat, develop conservation plans to protect water quality	Varies by program; \$300,000 for six-year term for WHIP, AMA up to \$50,000	Varies by program AMA: 75% WHIP: 75% CREP: 50%	Varies by program; Maximum 10-year enrolment for EQIP with six-year terms, CREP 10-15 years

APPENDIX D

Chesapeake Bay Program Pollutant Load Reduction Efficiencies

The effectiveness estimates for best management practices (BMPs) that are implemented and reported by the Chesapeake Bay partners, as well as those planned for future implementation, were obtained from the Documentation for Scenario Builder Version 2.4, which was revised January 2013 (U.S. EPA, 2013). These estimates are the most recent at the time of SWAP development. The BMP effectiveness estimates are extracted from Tables 8-4 and 8-5 from this documentation. In addition, recommendations from two recent Chesapeake Bay Program BMP Expert Panels which provide updated efficiencies for Urban Nutrient Management and urban stream restoration were used in this SWAP. The revised BMP effectiveness estimates from two other Expert Panel reports, Urban Stormwater Retrofit Expert Panel and New State Stormwater Performance Standards, were not applied given the detailed information on individual BMPs needed to estimate the value, and therefore values in Tables 8-4 and 8-5 were used. The values in these tables are considered “default” effectiveness estimates and are still applicable to estimate nutrient and sediment pollutant load reductions.

Recommendations of the Urban Stormwater Retrofit Expert Panel (approved October 2012)

The Panel developed a protocol whereby the removal rate for each individual retrofit project is determined based on the amount of runoff it treats and the degree of runoff reduction it provides. The Panel conducted an extensive review of recent BMP performance research and developed a series of retrofit removal adjustor curves to define sediment, nitrogen and phosphorus removal rates. The Panel then developed specific calculation methods tailored for different retrofit categories.

Runoff reduction is defined as the total post development runoff volume that is reduced through canopy interception, soil amendments, evaporation, rainfall harvesting, engineered infiltration, extended filtration or evapo-transpiration. Retrofit projects that achieve at least a 25% reduction of the annual runoff volume are classified as providing Runoff Reduction (RR), and therefore earn a higher net removal rate. Retrofit projects that employ a permanent pool, constructed wetlands or sand filters have less runoff reduction capability, and their removal rate is determined using the Stormwater Treatment (ST) curve.

In order to determine the runoff volume treated by a retrofit practice, the designer must first estimate the Runoff Storage volume (RS) in acre-feet. This, along with the Impervious Area (IA) in acres, is used to determine the amount of runoff volume in inches treated at the site. Once the amount of runoff captured by the practice is determined, the retrofit removal adjustor curves make it easy to determine pollutant removal rates for individual stormwater retrofits. The designer first defines the runoff depth treated by the project (on the x-axis), and then determines whether the project is classified as having runoff reduction (RR) or stormwater treatment (ST) capability. The designer then goes upward to intersect with the appropriate curve, and moves to the left to find the corresponding removal rate on the y-axis.

For more information, the report is available at:
http://stat.chesapeakebay.net/?q=node/130&quicktabs_10=3.

Recommendations of the New State Stormwater Performance (approved October 2012)

The Panel developed a protocol whereby the removal rate for each individual BMP is determined based on the type of BMP, a runoff reduction (RR) or stormwater treatment (ST) practice, and the amount of runoff it treats and the degree of runoff reduction it provides. The Panel conducted an extensive review of recent BMP performance research and developed a series of BMP performance removal adjustor curves to define sediment, nitrogen and phosphorus removal rates. The Panel then developed specific calculation methods tailored for different retrofit categories.

Runoff reduction is defined as the total post-development runoff volume that is reduced through canopy interception, soil amendments, evaporation, rainfall harvesting, engineered infiltration, extended filtration or evapo-transpiration. Stormwater practices that achieve at least a 25% reduction of the annual runoff volume are classified as providing RR, and therefore earn a higher net removal rate. Stormwater practices that employ a permanent pool, constructed wetlands or sand filters have less runoff reduction capability, and their removal rate is determined using the stormwater treatment ST curve. The removal rates determined from the new BMP removal rate adjustor curves are applied to the entire site area, and not just the impervious acres.

The protocol is used to account for nutrient reduction associated with the implementation of more BMPs for redevelopment projects. The general approach to estimate the pollutant load reduction is similar to new development with some modifications. For example, the area treated is limited to impervious acres, rather than the total site. Overall, the stormwater standards for redevelopment tend to be lower than for new development.

For more information, the report is available at:
http://stat.chesapeakebay.net/?q=node/130&quicktabs_10=3.

Recommendations of the Urban Nutrient Management Expert Panel (approved March 2013)

The Panel recommended three types of nutrient reduction credits. The first is an automatic state-wide P reduction credit starting in 2013 that reflects declines in P fertilizer application rates due to recent state phosphorus fertilizer legislation and the gradual industry phase out of P in fertilizer products. The exact reduction varies by state, but is about 25% for states that have adopted legislation and 20% for those that have not.

The automatic credit expires in three years, and will be replaced by a more verifiable and variable credit based on declines in unit area P application rates derived from improved non-farm fertilizer sales statistics. States may also be eligible for a state-wide N reduction credit in 2014 if they can document declines in unit N fertilizer applications relative to the current application rate benchmark employed in the CBWM. States that implement N fertilizer regulations that satisfy certain verification requirements may also qualify for an automatic N credit.

The second credit is a removal rate for the acreage of pervious land covered by qualifying Urban Nutrient Management (UNM) practices, based on the site risk for N and P export. For low risk lawns, the UNM load reductions for TN and TP are 3 and 6% respectively. The load reductions increase when UNM practices are applied to high risk lawns (20% TN, 10% TP). These reductions may be applied by local jurisdictions in Maryland for unfertilized lawns.

A third credit is applicable only to Maryland and is based on the Fertilizer Use Act 2011. Maryland is the only Bay state that is currently eligible for an automatic N reduction credit based on the provisions of its law. A credit for acres of turfgrass fertilized by commercial applicators are eligible for a 9% TN reduction and a 4.5% TN reduction is eligible for "do-it-yourself" fertilizer applicators.

A summary of the urban nutrient management credits is provided in the table below. For more information, the report is available at:
http://stat.chesapeakebay.net/?q=node/130&quicktabs_10=3.

Summary of Urban Fertilizer Management Credits for Phosphorus and Nitrogen			
Nutrient	*Statewide with P fertilizer legislation*	*Statewide without P fertilizer legislation*	*Urban Nutrient Management UNM²*
Phosphorus	25%	20%	Low risk: 3% High risk: 10% Blended: 4.5%
Notes & Conditions of Credit	Effective 2013 for 3 years. In 2016, need to show reduction in P using two years of fertilizer sales data		Need to survey high-risk every 5 years; Renew UNM every 3 years
Nitrogen	For States with N fertilizer legislation: 9% reduction for qualifying acres by commercial applicators, 4.5% reduction for do-it-yourselfer acres For all other States: 3% load reduction for every 10% decrease in N urban fertilizer input from CBWM benchmark		Low risk: 6% High risk: 20% Blended: 9%
Notes & Conditions of Credit	Effective 2014, need to show N reduction using two consecutive years sales data		Need to survey high-risk every 5 years; Renew UNM every 3 years

Recommendations of the Stream Restoration Expert Panel (approved May 2013, updated February 2014)

The Panel crafted four general protocols that can be used to define the pollutant load reductions associated with individual stream restoration projects. The following protocols apply for smaller $0 - 3^{rd}$ order stream reaches not simulated in the Chesapeake Bay Watershed Model (CBWM). These protocols do not apply to sections of streams that are tidally influenced, which will be included in either the Shoreline Erosion Control Expert Panel or a pending future Expert Panel for tidal wetlands:

Protocol 1: Credit for Prevented Sediment during Storm Flow -- This protocol provides an annual mass nutrient and sediment reduction credit for qualifying stream restoration practices that prevent channel or bank erosion that would otherwise be delivered downstream from an actively enlarging or incising urban stream.

- Protocol 2: Credit for Instream and Riparian Nutrient Processing during Base Flow -- This protocol provides an annual mass nitrogen reduction credit for qualifying projects that include design features to promote denitrification during base flow within the stream channel through hyporheic exchange within the riparian corridor.

- Protocol 3: Credit for Floodplain Reconnection Volume-- This protocol provides an annual mass sediment and nutrient reduction credit for qualifying projects that reconnect stream channels to their floodplain over a wide range of storm events.

- Protocol 4: Credit for Dry Channel RSC as an Upland Stormwater Retrofit-- This protocol provides an annual nutrient and sediment reduction rate for the contributing drainage area to a qualifying dry channel RSC project. The rate is determined by the degree of stormwater treatment provided in the upland area using the retrofit rate adjustor curves developed by the Stormwater Retrofit Expert Panel.

An individual stream restoration project may qualify for credit under one or more of the protocols, depending on its design and overall restoration approach. The results of stream restoration BMPs will be reported to the CBP as TN, TP, and TSS total load reduction. However, the interim rate in Table 8-5 will continue to be applied to historic projects and new projects that cannot conform to recommended reporting requirements. In addition, the interim rate will continue to be used for planning purposes and will be the efficiency used in the Maryland Assessment Scenario Tool. For more information on the protocols, the report is available at: http://stat.chesapeakebay.net/?q=node/130&quicktabs_10=3.

BMP Efficiencies from the Documentation for Scenario Builder 2.4

Table 8-4: Maximum and minimum BMP efficiencies

Sector	BMP	Nitrogen Effectiveness Minimum	Nitrogen Effectiveness Maximum	Phosphorus Effectiveness Minimum	Phosphorus Effectiveness Maximum	Sediment Effectiveness Minimum	Sediment Effectiveness Maximum	Interim
Agriculture	Barnyard Runoff Control	20	20	20	20	40	40	N
Agriculture	Commodity Cover Crop Early Arial Rye	8	10	0	0	0	0	N
Agriculture	Commodity Cover Crop Early Arial Wheat	6	7	0	0	0	0	N
Agriculture	Commodity Cover Crop Early Drilled Barley	13	17	0	0	0	0	N
Agriculture	Commodity Cover Crop Early Drilled Rye	19	25	0	0	0	0	N
Agriculture	Commodity Cover Crop Early Drilled Wheat	13	17	0	0	0	0	N
Agriculture	Commodity Cover Crop Early Other Rye	16	21	0	0	0	0	N
Agriculture	Commodity Cover Crop Early Other Wheat	11	15	0	0	0	0	N
Agriculture	Commodity Cover Crop Early-Planting Aerial Corn Barley	6	7	0	0	0	0	N
Agriculture	Commodity Cover Crop Early-Planting Aerial Soy Barley	9	12	0	0	0	0	N
Agriculture	Commodity Cover Crop Early-Planting Aerial Soy Rye	13	17	0	0	0	0	N
Agriculture	Commodity Cover Crop Early-Planting Aerial Soy Wheat	9	12	0	0	0	0	N
Agriculture	Commodity Cover Crop Early-Planting Other Barley	11	15	0	0	0	0	N
Agriculture	Commodity Cover Crop Late Other Wheat	5	6	0	0	0	0	N
Agriculture	Commodity Cover Crop Late-Planting Drilled Rye	9	11	0	0	0	0	N
Agriculture	Commodity Cover Crop Late-Planting Drilled Wheat	6	7	0	0	0	0	N
Agriculture	Commodity Cover Crop Late-Planting Other Rye	7	9	0	0	0	0	N
Agriculture	Commodity Cover Crop Standard Drilled Rye	16	21	0	0	0	0	N
Agriculture	Commodity Cover Crop Standard Other Rye	14	18	0	0	0	0	N
Agriculture	Commodity Cover Crop Standard Other Wheat	9	12	0	0	0	0	N
Agricultu	Commodity Cover Crop Standard-	11	15	0	0	0	0	N

re	Planting Drilled Barley							
Agriculture	Commodity Cover Crop Standard-Planting Drilled Wheat	11	15	0	0	0	0	N
Agriculture	Commodity Cover Crop Standard-Planting Other Barley	10	12	0	0	0	0	N
Agriculture	Conservation Till Without Nutrients	7	7	18	18	31	31	Y
Agriculture	Continuous No Till	10	15	20	40	70	70	N
Agriculture	Cover Crop Early Arial Barley	12	15	0	15	0	20	N
Agriculture	Cover Crop Early Arial Rye	14	18	0	15	0	20	N
Agriculture	Cover Crop Early Arial Wheat	10	12	0	15	0	20	N
Agriculture	Cover Crop Early Drilled Rye	34	45	0	15	0	20	N
Agriculture	Cover Crop Early Drilled Wheat	24	31	0	15	0	20	N
Agriculture	Cover Crop Early Other Rye	29	38	0	15	0	20	N
Agriculture	Cover Crop Early Other Wheat	20	27	0	15	0	20	N
Agriculture	Cover Crop Early-Planting Aerial Soy Barley	20	27	0	15	0	20	N
Agriculture	Cover Crop Early-Planting Aerial Soy Rye	24	31	0	15	0	20	N
Agriculture	Cover Crop Early-Planting Aerial Soy Wheat	17	22	0	15	0	20	N
Agriculture	Cover Crop Early-Planting Drilled Barley	29	38	0	15	0	20	N
Agriculture	Cover Crop Early-Planting Other Barley	25	32	0	15	0	20	N
Agriculture	Cover Crop Late Drilled Rye	15	19	0	0	0	0	N
Agriculture	Cover Crop Late Other Wheat	9	11	0	0	0	0	N
Agriculture	Cover Crop Late-Planting Drilled Wheat	10	13	0	0	0	0	N
Agriculture	Cover Crop Late-Planting Other Rye	12	16	0	0	0	0	N
Agriculture	Cover Crop Standard Drilled Barley	22	29	0	7	0	10	N
Agriculture	Cover Crop Standard Drilled Rye	31	41	0	7	0	10	N
Agriculture	Cover Crop Standard Drilled Wheat	22	29	0	7	0	10	N
Agriculture	Cover Crop Standard Other Barley	19	24	0	7	0	10	N
Agriculture	Cover Crop Standard Other Rye	27	35	0	7	0	10	N
Agriculture	Cover Crop Standard Other Wheat	19	24	0	7	0	10	N
Agriculture	Cropland Irrigation Management	4	4	0	0	0	0	Y
Agriculture	Dairy Manure Injection	25	25	0	0	0	0	Y
Agriculture	Decision Agriculture	3.5	3.5	0	0	0	0	N
Agriculture	Enhanced Nutrient Management	7	7	0	0	0	0	N
Agricultu	Forest Buffers	0	65	0	45	0	60	N

re								
Agriculture	Forest Buffers	0	65	0	45	0	60	N
Agriculture	Grass Buffers; Vegetated Open Channel - Agriculture	0	46	0	45	0	60	N
Agriculture	Grass Buffers; Vegetated Open Channel - Agriculture	0	46	0	45	0	60	N
Agriculture	Horse Pasture Management	0	0	20	20	40	40	N
Agriculture	Irrigation Water Capture Reuse	75	75	75	75	0	0	Y
Agriculture	Loafing Lot Management	20	20	20	20	40	40	N
Agriculture	No Till allowing combinations with other practices	5	5	10	10	20	20	Y
Agriculture	Off Stream Watering Without Fencing	5	5	8	8	10	10	N
Agriculture	Poultry Litter Injection	25	25	0	0	0	0	Y
Agriculture	Precision Intensive Rotational Grazing	9	11	24	24	30	30	N
Agriculture	Prescribed Grazing	9	11	24	24	30	30	N
Agriculture	Soil Conservation and Water Quality Plans	3	8	5	15	8	25	N
Agriculture	Sorbing Materials in Ag Ditches	0	0	40	40	0	0	Y
Agriculture	Streamside Forest Buffers	0	65	0	45	0	60	N
Agriculture	Streamside Forest Buffers	0	65	0	45	0	60	N
Agriculture	Streamside Grass Buffers	0	46	0	45	0	60	N
Agriculture	Streamside Grass Buffers	0	46	0	45	0	60	N
Agriculture	Streamside Wetland Restoration	7	25	12	50	4	15	N
Agriculture	Water Control Structures	33	33	0	0	0	0	N
Agriculture	Wetland Restoration	7	25	12	50	4	15	N
Forest	Forest Harvesting Practices	50	50	60	60	60	60	N
Urban	Bioretention/raingardens - A/B soils, no underdrain	80	80	85	85	90	90	N
Urban	Bioretention/raingardens - A/B soils, underdrain	70	70	75	75	80	80	N
Urban	Bioretention/raingardens - C/D soils, underdrain	25	25	45	45	55	55	N
Urban	Bioswale	70	70	75	75	80	80	N
Urban	Dry Detention Ponds and Hydrodynamic Structures	5	5	10	10	10	10	N
Urban	Dry Extended Detention Ponds	20	20	20	20	60	60	N
Urban	Erosion and Sediment Control	25	25	40	40	40	40	N
Urban	Erosion and Sediment Control on Extractive, excess applied to all other pervious urban	25	25	40	40	40	40	Y
Urban	MS4 Permit-Required Stormwater Retrofit	25	25	35	35	65	65	N
Urban	Permeable Pavement w/ Sand, Veg. - A/B soils, no underdrain	80	80	80	80	85	85	N
Urban	Permeable Pavement w/ Sand, Veg. - A/B soils, underdrain	50	50	50	50	70	70	N

Urban	Permeable Pavement w/ Sand, Veg. - C/D soils, underdrain	20	20	20	20	55	55	N
Urban	Permeable Pavement w/o Sand, Veg. - A/B soils, no underdrain	75	75	80	80	85	85	N
Urban	Permeable Pavement w/o Sand, Veg. - A/B soils, underdrain	45	45	50	50	70	70	N
Urban	Permeable Pavement w/o Sand, Veg. - C/D soils, underdrain	10	10	20	20	55	55	N
Urban	Stormwater Management by Era 1985 to 2002 MD	17	17	30	30	40	40	N
Urban	Stormwater Management by Era 2002 to 2010 MD	30	30	40	40	80	80	N
Urban	Stormwater to the Maximum Extent Practicable (SW to the MEP)	50	50	60	60	90	90	N
Urban	Street Sweeping 25 times a year-acres (formerly called Street Sweeping Mechanical Monthly)	3	3	3	3	9	9	N
Urban	Urban Filtering Practices	40	40	60	60	80	80	N
Urban	Urban Forest Buffers	25	25	50	50	50	50	N
Urban	Urban Infiltration Practices w/ Sand, Veg. - A/B soils, no underdrain	85	85	85	85	95	95	N
Urban	Urban Infiltration Practices w/o Sand, Veg. - A/B soils, no underdrain	80	80	85	85	95	95	N
Urban	Urban Nutrient Management	17	17	22	22	0	0	N
Urban	Vegetated Open Channels - A/B soils, no underdrain	45	45	45	45	70	70	N
Urban	Vegetated Open Channels - C/D soils, no underdrain	10	10	10	10	50	50	N
Urban	Wet Ponds and Wetlands	20	20	45	45	60	60	N

Table 8-5: Unit load reduction BMPs

Sector	BMP	Unit	Nitrogen Reduction Factor	Phosphorus Reduction Factor	Sediment Reduction Factor	Interim
Agriculture	Dirt & Gravel Road Erosion & Sediment Control - Driving Surface Aggregate + Raising the Roadbed	feet	NULL	NULL	2.96	N
Agriculture	Dirt & Gravel Road Erosion & Sediment Control - Outlets only	feet	NULL	NULL	1.76	N
Agriculture	Dirt & Gravel Road Erosion & Sediment Control - with Outlets	feet	NULL	NULL	3.6	N
Agriculture	Non Urban Stream Restoration	feet	0.02	0.0025	2	N
Agriculture	Non Urban Stream Restoration (interim)	feet	0.2	0.068	310	Y
Agriculture	Shoreline Erosion Control	feet	0.02	0.0025	2	N
Forest	Dirt & Gravel Road Erosion & Sediment Control - Driving Surface Aggregate + Raising the Roadbed	feet	NULL	NULL	2.96	N
Forest	Dirt & Gravel Road Erosion & Sediment Control - Outlets only	feet	NULL	NULL	1.76	N
Forest	Dirt & Gravel Road Erosion & Sediment Control - with Outlets	feet	NULL	NULL	3.6	N
Forest	Non Urban Stream Restoration	feet	0.02	0.0025	2	N
Forest	Non Urban Stream Restoration (interim)	feet	0.2	0.068	310	Y
Forest	Shoreline Erosion Control	feet	0.02	0.0025	2	N
Urban	Dirt & Gravel Road Erosion & Sediment Control - Driving Surface Aggregate + Raising the Roadbed	feet	NULL	NULL	2.96	N
Urban	Dirt & Gravel Road Erosion & Sediment Control - Outlets only	feet	NULL	NULL	1.76	N
Urban	Dirt & Gravel Road Erosion & Sediment Control - with Outlets	feet	NULL	NULL	3.6	N
Urban	Regenerative Stormwater Conveyance	feet	0.02	0.0025	2	N
Urban	Shoreline Erosion Control	feet	0.02	0.0025	2	N
Urban	Street Sweeping 25 times a year-lbs	lbs	0.00175	0.0007	1	N
Urban	Street Sweeping Pounds	lbs	NULL	NULL	1	N
Urban	Urban Stream Restoration	feet	0.02	0.0025	2	N
Urban	Urban Stream Restoration (interim)	feet	0.2	0.068	310	Y

Baltimore County Agricultural Reduction Summary Table

				6/30/2009			7/1/2009 - 3/31/2011			2020			2 yr milestone (12-13)			
BMP	Units	N Red* lb/unit	P Red* lb/unit	Impl	N Red	P Red	Impl	N Red	P Red	Impl	N Red	P Red	Impl	N Red	P Red	Notes
Conservation Tillage	acres	4.61	1.13	25,997	119,848	29,377		0	0		0	0		0	0	2000 info
Continuous No-Till	acres/yr				0	0		0	0		0	0		0	0	
Cover Crops - Commodity	acres/yr	2.88		2,185	6,293	0		0	0		0	0		0	0	
Cover Crops - Traditional Private	acres/yr	8.92	0	1,785	15,922	0		0	0	2,000	17,840	0		0	0	
Dairy Manure Incorporation	acres	8.8	0		0	0		0	0		0	0		0	0	SCD consider purchase of turbo till for rental program
Decision/Precision Agriculture	acres	4.04	0.48		0	0		0	0		0	0		0	0	
Manure Transport	tons/yr	12			0	0		0	0		0	0		0	0	
Manure Transport Alt Use Out of Watershed	tons/yr			149	0	0		0	0		0	0		0	0	
Nutrient Mgmnt Plan Impl	acres/yr	3.11	0.3	39,577	123,084	11,873		0	0		0	0		0	0	2010 MDA AIR Submissions
Poultry Manure Incorporation	acres	5.2	0		0	0		0	0		0	0		0	0	
Water Irrigation Mgmnt	acres	[illegible]	0	868	5,981	0		0	0		0	0		0	0	2007 Ag Census Data
Heavy Use Area -Poultry Pad	operation	330	0		0	0		0	0		0	0		0	0	
Heavy Use Area -Livestock	acres	330	0	3.4	1,122	0	1.5	495	0	1	330	0		0	0	
Livestock Waste Structures	structures	531	104	4	2,124	416	2	1,062	208	8	4,248	832		0	0	need funding for 5 small horse operations (less than 6 horses)
Poultry Waste Structures	structures	210	42		0	0		0	0		0	0		0	0	
Retirement of Highly Erodible Land - Private	acres	9.55	0.03	172	1,646	5	6	59	0	24	229	1		0	0	
Runoff Control Systems	systems	69	13	27	1,863	351	8	552	104	16	1,104	208		0	0	
Soil Conservation & Water Quality Plans	acres/yr	0.93	0.14	27,351	25,437	3,829	6,597	6,135	924		0	0		0	0	ease plan acreage need additional planner (13700 ac) need marketing/outreach for e
Stream Protection with Fencing	acres	6.79	0.91	847	5,753	771	188	1,274	171	118	798	107		0	0	
Stream Protection without Fencing	acres	3.4	0.46	2,505	8,517	1,152	240	816	110	360	1,224	166		0	0	
Stream Restoration(Ag) in Non-Coastal Plain	lf	0.02	0.0035		0	0		0	0	1,400	28	5		0	0	
Streamside Forest Buffers Private	acres	28.72	1.94	211	6,066	410	0	0	0	100	2,872	194		0	0	
Streamside Grassed Buffers - Private	acres	17.06	0.82	22	367	18	0	0	0		0	0		0	0	
Water Control Structures	acres/yr	3	0	400	1,200	0		0	0		0	0		0	0	Average 200 ac/structure
Wetland Restoration - Private	acres	28.72	1.94	26	735	50	50	1,427	96		0	0		0	0	
Alt crops/switchgrass		17.06	0.82		0	0		0	0		0	0		0	0	
Ammonia emission reduction (PLT)	operation				0	0		0	0		0	0		0	0	
Animal Mortality Composter	structures															need funding for implementation
Assmnt Non CS BMPs	acres				0	0		0	0		0	0		0	0	need staff to capture this
Horse Pasture Management	acres			21			3			20						need for forage specialist and study of species for horses
Livestock Pasture Management	acres															
Loss of Ag Land	acres	11			0	0		0	0	200	2,200	0		0	0	need to confirm with co permit office
Structural, vegetative, & non-structural shore erosion	miles				0	0		0	0		0	0		0	0	
Vegetated Open Channels	linear ft				0	0		0	0		0	0		0	0	
Vegetative Environmental Buffer	operation	26	0		0	0		0	0		0	0		0	0	
Total					325,957	48,252		11,821	1,613		30,873	1,512		-	-	

* based on CBP 4.3 model reductions

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